APCUPSD User Manual

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Apcupsd is a UPS control system that permits orderly shutdown of your computer in the event of a power failure.

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This manual documents apcupsd version 3.14.x
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For more information on the project, please visit the main web site at http://www.apcupsd.com

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Important Legal Disclaimer **6**
How To Use This Manual **7**
Basic User's Guide **7**
Quick Start for Beginners 7
Supported Operating Systems 8
Platform Support 8
Supported UPSes and Cables 9
Choosing a Configuration Type 10
Configuration types 10
USB Configuration **12**
Linux USB Configuration 12
Known Linux USB Issues 12
Verifying Device Detection and Driver 13
Device Nodes 14
Miscellaneous 16
BSD USB Configuration 16
Known BSD USB Issues 16
Platforms and Versions 16
Kernel Configuration 16
Verifying Device Detection and Driver 17

Device Nodes 18
Windows USB Configuration 18
Platforms and Versions 18
USB Driver Installation 18
Verifying Device Detection and Driver 18
Solaris USB Configuration 18
Platforms and Versions 18
Building Apcupsd with USB 18
Verifying Device Detection and Driver 19
Device Nodes 19
Mac OS X (Darwin) USB Configuration 19
Platforms and Versions 19
Building Apcupsd with USB 19
Verifying Device Detection and Driver 20
Building and Installing apcupsd 20
Installation from Binary Packages 20
RPMS 20
Microsoft Windows 20
Installation from Source 20
Verifying a Source Installation 22
Configure Options 23
Recommended Options for most Systems 25
Compilers and Options 26
Operating System Specifics 26
Debian 27
FreeBSD 27
HPUX 27
NetBSD 27
Mac OS X Darwin 27
OpenBSD 27
Red Hat Systems 27
Slackware 28
SUSE 28
Sun Solaris 28
Unknown System 30
Windows Systems 30
After Installation 30
Checking Your Configuration File 30

Arranging for Reboot on Power-Up 30
Making sure apcupsd Is Running 31
Configuration Examples 32
A Simple USB Configuration 32
A Simple Configuration for a Serial SmartUPS 32
A Simple Configuration for a Simple Signaling or Dumb 32
NIS Server/Client Configuration Using the Net Driver 33
Differences between NIS Client/Server and the old (now removed) Master/Slave modes 34
PowerChute Network Shutdown Driver (PCNET) 34
MODBUS Driver 35
Testing Apcupsd 36
Process-Status Test 36
Logging Test 36
apcaccess Test 36
Communications Test 38
Simulated Power Fail Test 39
System Shutdown Test 40
Full Power Down Test 40
apctest 41
Monitoring and Tuning your UPS 42
apcaccess 42
Apcupsd Notification and Events 43
apcupsd Network Monitoring (CGI) Programs 44
Setting up and Testing the CGI Programs 44
Using the CGI Programs on Windows 45
multimon.cgi 46
upsstats.cgi 46
upsfstatus.cgi 46
A Tip from Carl Erhorn for Sun Systems: 47
CGI Credits 47
Security Issues: 48
Firewall Settings 48
TCP Wrappers 48
Configuring Your EEPROM 48
Using apctest to Configure Your EEPROM 48
Maintaining Your UPS Batteries 48
Battery Technology 48

Battery Life 49
Flashing Battery Charge Graph LEDs 50
Battery Replacement 50
Battery Installation 51
"Soft" Runtime Calibration 51
"Manual" Runtime Calibration 52
Resetting the UPS Battery Constant 53
Frequently-Asked Questions 55
Customizing Event Handling 57
apccontrol Command Line Options 57
Controlling Multiple UPSes on one Machine 59
Multiple UPS Example 59
Support for SNMP UPSes 62
Planning and Setup for SNMP Wiring 62
Planning and Setup for SNMP Configuration 62
Assign SNMP Card IP Address 62
Set SNMP card General Parameters 63
Set SNMP card Shutdown Parameters 64
Configure Event Trap Receivers 64
Connecting APCUPSD to a SNMP UPS 65
Building with SNMP support 65
SNMP Trap Catching 66
Known Problems 66
apcupsd System Logging 66
Logging Types 66
Data Logging 67
Status Logging 67
EVENTS Logging 67
Implementation Details 67
The Windows Version of apcupsd 68
Installing Apcupsd on Windows 68
Configuring Apcupsd on Windows 68
Starting Apcupsd on Windows 69
Apctray 69
Testing Apcupsd on Windows 70
Upgrading 70
Post-Installation 70
Problem Areas 70

Email Notification of Events 71
Killpower under Windows 71
Power Down During Shutdown 71
Command Line Options Specific to the Windows Version 72
Installation: Serial-Line UPSes 72
Overview of Serial-Interface UPSes 72
Connecting a Serial-Line UPS to a USB Port 72
Testing Serial-Line UPSes 73
Establishing Serial Port Connection 73
Once you have established serial communications 74
Troubleshooting Serial Line communications 74
Bizarre Intermittent Behavior: 74
Cables 75
Smart-Custom Cable for SmartUPSes 75
Simple-Custom Voltage-Signalling Cable for "dumb" UPSes 75
Custom-RJ45 Smart Signalling Cable for BackUPS CS Models 77
Other APC Cables that apcupsd Supports 78
Voltage Signalling Features Supported by Apcupsd for Various Cables 78
Voltage Signalling 78
The Back-UPS Office 500 signals 79
Analyses of APC Cables 79
940-0020B Cable Wiring 79
940-0020C Cable Wiring 80
940-0023A Cable Wiring 80
940-0024C Cable Wiring 81
940-0095A Cable Wiring 81
940-0095B Cable Wiring 82
940-0119A Cable Wiring 83
Serial BackUPS ES Wiring 83
940-0128A Cable Wiring 84
940-0128D Cable Wiring 85
940-0127B Cable Wiring 86
Win32 Implementation Restrictions for Simple UPSes 86
Recalibrating the UPS Runtime 86
Configuration Directive Reference 87
General Configuration Directives 87
Configuration Directives Used by the Network Information Server 88
Configuration Directives used during Power Failures 89

Configuration Directives used to Control System Logging 91
Configuration Directives for Sharing a UPS 91
Configuration Directives Used to Set the UPS EEPROM 91
apcupsd Status Logging 93
Status report format 93
Status Report Example 93
Status Report Fields 94
Logging the STATUS Information 97
The Shutdown Sequence and its Discontents 97
Shutdown Sequence 97
Shutdown Problems 99
Master/Slave Shutdown 99
Startup 99
Windows Considerations 100
APC smart protocol 100
Description 100
RS-232 differences 100
The Smart Protocol 100
Dip switch info 106
Status bits 106
Alert messages 106
Register 1 107
Register 2 107
Register 3 108
Interpretation of the Old Firmware Revision 108
Interpretation of the New Firmware Revision 109
EEPROM Values 109
Programming the UPS EEPROM 110
NIS Network Server Protocol 111
Apcupsd RPM Packaging FAQ 111
Credits 113
Contributors 113
Apcupsd License 114
Other Open Source Licenses 114

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How To Use This Manual

This is the manual for apcupsd, a daemon for communicating with UPSes (Uninterruptible Power Supplies) made by American Power Conversion Corporation (APC). If you have an APC-made UPS, whether sold under the APC nameplate or OEMed (for example, the HP PowerTrust 2997A), and you want you get it working with a computer running Linux, Unix, or Windows, you are reading the right document.

This manual is divided into parts which increase in technical depth as they go. If you have just bought a state-of-the-art smart UPS with a USB or Ethernet interface, and you are running a current version of Red Hat or SUSE Linux, then apcupsd is very nearly plug-and-play and you will have to read only the Basic User's Guide.

If your operating system is older, or if you have an old-fashioned serial-line UPS, you'll have to read about serial installation (see Installation: Serial-Line UPSes). If you need more details about administration for unusual situations (such as a master/slave or multi-UPS setup) you'll need to read the sections on those topics as well. Finally, there are a number of technical reference sections which gives full details on things like configuration file directives and event-logging formats.

You should begin by reading the Quick Start (see Quick Start for Beginners) instructions.

Basic User's Guide

Quick Start for Beginners

apcupsd is a complex piece of software, but most of its complexities are meant for dealing with older hardware and operating systems. On current hardware and software getting it running should not be very complicated.

The following is a help guide to the steps needed to get apcupsd set up and running as painlessly as possible.

1. Check to see if apcupsd supports your UPS and cable (see Supported UPSes and Cables).
2. Check to see if apcupsd supports your operating system (see Supported Operating Systems).
3. Plan your configuration type (see Choosing a Configuration Type). If you have just one UPS and one computer, this is easy. If you have more than one machine being served by the same UPS, or more than one UPS supplying power to computers that are on the same local network, you have more choices to make.
4. Figure out if you have one of the easy setups. If you have a USB UPS, and a supported operating system and you want to use one UPS with one computer, that's an easy setup. APC supplies the cable needed to talk with that UPS along with the UPS. All you need to do is check that your USB

subsystem is working (see USB Configuration); if so, you can go to the build and install step.

5. If you have a UPS designed to communicate via SNMP over Ethernet, that is also a relatively easy installation. Details are provided in Support for SNMP UPSes.
6. If you have a UPS that communicates via an RS232C serial interface and it is a SmartUPS, then things are relatively simple, otherwise, your life is about to get interesting.
    1. If you have a vendor-supplied cable, find out what cable type you have by looking on the flat ends of the cable for a number, such as 940-0020A, stamped in the plastic.
    2. If you don't have a vendor-supplied cable, or your type is not supported, you may have to build one yourself (see Cables). Here is hoping you are good with a soldering iron!
7. Now you are ready to read the Building and Installing (see Building and Installing apcupsd) section of the manual and follow those directions. If you are installing from an RPM or some other form of binary package, this step will probably consist of executing a single command.
8. Tweak your /etc/apcupsd/apcupsd.conf file as necessary. Often it will not be.
9. Change the BIOS settings (see Arranging for Reboot on Power-Up) on your computer so that boots up every time it gets power. (This is not the default on most systems.)
10. To verify that your UPS is communicating with your computer and will do the right thing when the power goes out, read and follow the instructions in the Testing (see Testing Apcupsd) section.
11. If you run into problems, check the apcupsd users' email list archive for similar problems. This is an excellent resource with answers to all sorts of questions. See http://sourceforge.net/mailarchive/forum.php?forum_name=apcupsd-users.
12. If you still need help, send a message to the apcupsd users' email list (apcupsd-users@lists.sourceforge.net) describing your problem, what version of apcupsd you are using, what operating system you are using, and anything else you think might be helpful.
13. Read the manual section on Monitoring and Tuning your UPS.

Supported Operating Systems

apcupsd supports many UNIX-like operating systems as well as several variants of Windows. Due to lack of API standardization, USB support is not available on every platform. See Platform Support below for details.

In general it is recommended to obtain a prebuilt package for your platform. Given how apcupsd must integrate into the shutdown mechanism of the operating system and the rate at which such mechanisms are changed by vendors, the platform ports in the apcupsd tree may become out of date. In some cases, binary packages are provided by the apcupsd team (RedHat, Mandriva, SuSE, Windows, Mac OS X). For other platforms it is recommended to check your vendor's package repository and third party repositories for recent binary packages. Note that some vendors continue to distribute ancient versions of apcupsd with known defects. These packages should *not* be used.

Platform Support

LINUX

- RedHat [1] [2]
- SuSE [2]
- Mandriva/Mandrake [2]
- Debian [3]
- Slackware [3]
- Engarde [3]
- Yellowdog [3]

- Gentoo [3]

WINDOWS

- Windows NT 4 [2] [4]
- Windows 98/ME/2000 [2] [4]
- Windows XP/Vista (including 64 bit) [1] [2]
- Windows Server 2003/2008 (including 64 bit) [2]
- Windows 7 [2]

OTHERS

- Mac OS X Darwin [1] [2]
- Solaris 8/9 [4]
- Solaris 10
- NetBSD
- FreeBSD
- OpenBSD
- HPUX [3] [4]
- Unifix [3] [4]
- QNX [4]

Supported UPSes and Cables

apcupsd supports nearly every APC brand UPS model in existence and enough different cable types to connect to all of them.

The `UPSTYPE <keyword>` field is the value you will put in your /etc/apcupsd/apcupsd.conf file to tell apcupsd what type of UPS you have. We'll describe the possible values here, because they're a good way to explain your UPS's single most important interface property: the kind of protocol it uses to talk with its computer.

apcsmart

The 'apcsmart' protocol uses an RS232 serial connection to pass commands back and forth in a primitive language resembling modem-control codes. APC calls this language "UPS-Link". Originally introduced for Smart-UPS models (thus the name 'apcsmart'), this class of UPS is in decline, rapidly being replaced in APC's product line by USB and MODBUS UPSes.

usb

A USB UPS speaks a universal well defined control language over a USB wire. Most of APC's lineup now uses this method as of late 2003, and it seems likely to completely take over in their low- and middle range. The most recent APC UPSes support only a limited set of data over the USB interface. MODBUS (see below) is required in order to access the advanced data.

net

1	Platforms on which apcupsd is regularly developed and tested
2	Platforms for which apcupsd team distributes binary packages
3	Port included in apcupsd source tree but may be out of date, unmaintained, or broken.
4	USB not supported

This is the keyword to specify if you are using your UPS in Slave mode (i.e. the machine is not directly connected to the UPS, but to another machine which is), and it is connected to the Master via an ethernet connection. You must have apcupsd's Network Information Services NIS turned on for this mode to work.

snmp

SNMP UPSes communicate via an Ethernet NIC and firmware that speaks Simple Network Management Protocol.

dumb

A dumb or voltage-signaling UPS and its computer communicate through the control lines (not the data lines) on an RS232C serial connection. Not much can actually be conveyed this way other than an order to shut down. Voltage-signaling UPSes are obsolete; you are unlikely to encounter one other than as legacy hardware. If you have a choice, we recommend you avoid simple signalling UPSes.

pcnet

PCNET is an alternative for SNMP available on APC's AP9617 family of smart slot modules. The protocol is much simpler and potentially more secure than SNMP.

modbus

MODBUS is the newest APC protocol and operates over RS232 serial links or USB. MODBUS is APC's replacement for the aging 'apcsmart' (aka UPS-Link) protocol. MODBUS is the only way to access detailed control and status information on newer (esp. SMT series) UPSes.

Choosing a Configuration Type

There are three major ways of running apcupsd on your system. The first is a standalone configuration where apcupsd controls a single UPS, which powers a single computer. This is the most common configuration. If you're working with just one machine and one UPS, skip the rest of this section.

Your choices become more interesting if you are running a small cluster or a big server farm. Under those circumstances, it may not be possible or even desirable to pair a UPS with every single machine. apcupsd supports some alternate arrangements.

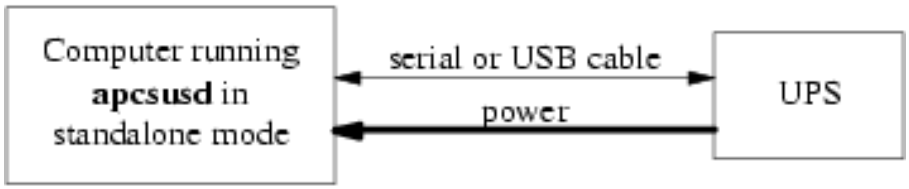
The second type of configuration is the NIS (Network Information Server) server and client. In this configuration, where one UPS powers several computers, a copy of apcupsd running one one computer will act as a server while the other(s) will act as network clients which poll the server for information about the UPS. Note that "NIS" is *not* related to Sun's directory service also called "NIS" or "Yellow Pages".

The third configuration is where a single computer controls multiple UPSes. In this case, there are several instances of apcupsd on the same computer, each controlling a different UPS. One instance of apcupsd will run in standalone mode, and the other instance will normally run in network mode. This type of configuration may be appropriate for large server farms that use one dedicated machine for monitoring and diagnostics

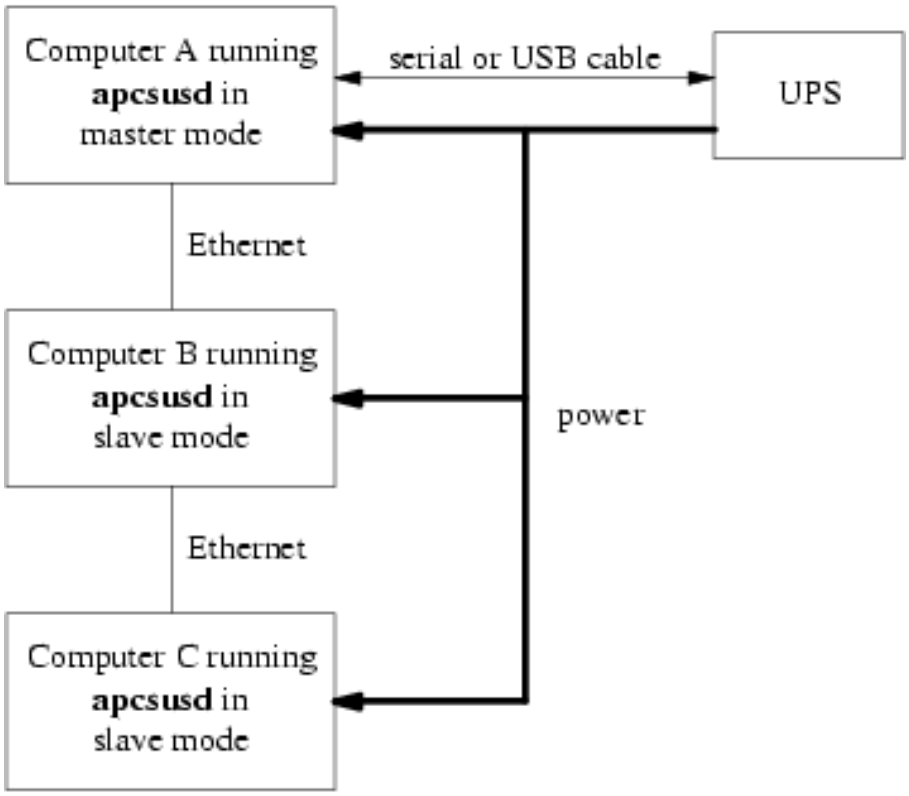
Here is a diagram that summarizes the possibilities:

Configuration types

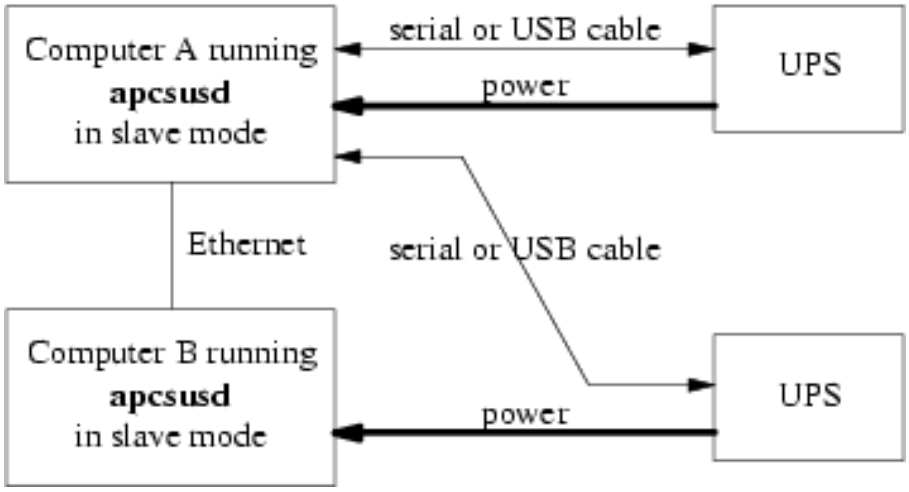
Stand alone configuration



Typical Master/Slave Configuration



Multi-UPS configuration



If you decide to set up one of these more complex configurations, see the dedicated section on that particular configuration.

USB Configuration

Apcupsd supports USB connections on all major operating systems: Linux, FreeBSD, OpenBSD, NetBSD, Windows, Solaris, and Mac OS X Darwin. If you plan to use a USB connection, please read the appropriate subsection in its entirety. You can skip this section if your UPS has a serial (RS232-C) or Ethernet interface or if you are not running one of the platforms listed above.

Linux USB Configuration

Known Linux USB Issues

Problem

Linux 2.4 series kernels older than 2.4.22 (RH 9, RHEL 3) do not bind the USB device to the proper driver. This is evidenced by /proc/bus/usb/devices listing the UPS correctly but it will have "driver=(none)" instead of "driver=(hid)". This affects RHEL3, among others.

Workaround

Upgrade linux kernel to 2.4.22 or higher. Alternately, you apply the linux-2.4.20-killpower.patch and linux-2.4.20-USB-reject.patch patches to your kernel and rebuild it. These patches can be found in the examples/ directory in the apcupsd source distribution.

Problem

Mandrake 10.0 and 10.1 systems with high security mode enabled (running kernel-secure kernel) use static device nodes but still assign USB minor numbers dynamically. This is evidenced by `hiddev0: USB HID v1.10 Device [...]` instead of `hiddev96: ...` in dmesg log.

Workaround

Boot standard kernel instead of kernel-secure or disable CONFIG_USB_DYNAMIC_MINORS and rebuild kernel-secure.

Problem

USB driver linux-usb.c fails to compile, reporting errors about `HID_MAX_USAGES undefined`. This is due to a defect in the linux kernel hiddev.h header file on 2.6.5 and higher kernels.

Workaround

Upgrade to apcupsd-3.10.14 or higher. These versions contain a workaround for the defect.

Problem

On some systems such as Slackware 10.0, no USB devices will show up (see the next section).

Workaround

Add the following to rc.local

```
mount -t usbdevfs none /proc/bus/usb
```

Problem

2.6 kernels use udev and some distributions to not configure it to automatically create /dev/usb/hiddev?? as they should, causing apcupsd to fail to locate the UPS.

Workaround

Edit the file /etc/udev/rules.d/50-udev.rules, and add the following:

```
KERNEL="hiddev*", NAME="usb/hiddev%n"
```

More details are provided in the following section ...

Verifying Device Detection and Driver

To make sure that your USB subsystem can see the UPS, just do this from a shell prompt:

```
cat /proc/bus/usb/devices
```

This information is updated by the kernel whenever a device is plugged in or unplugged, irrespective of whether apcupsd is running or not. It contains details on all the USB devices in your system including hubs (internal and external), input devices, and UPSes.

You should get some output back that includes something like this, featuring a BackUPS RS 1000:

```
T:  Bus=02 Lev=01 Prnt=01 Port=00 Cnt=01 Dev#=  3 Spd=1.5 MxCh= 0
D:  Ver= 1.10 Cls=00(>ifc ) Sub=00 Prot=00 MxPS= 8 #Cfgs=  1
P:  Vendor=051d ProdID=0002 Rev= 1.06
S:  Manufacturer=American Power Conversion
S:  Product=Back-UPS RS 1000 FW:7.g3 .D USB FW:g3
S:  SerialNumber=JB0308036505
C:* #Ifs= 1 Cfg#= 1 Atr=a0 MxPwr= 24mA
I:  If#= 0 Alt= 0 #EPs= 1 Cls=03(HID  ) Sub=00 Prot=00 Driver=hid
```

The important things to check for are the `S:` lines describing your UPS and and the `I:` line showing what driver is handling it. If on the `I:` line, `Driver` is listed as `Driver=none` then you do not have the HID driver loaded or the driver did not attach to the UPS. One common cause is having a Linux kernel older than 2.4.22 (such as a stock RedHat 9 or RHEL 3 kernel). If this is the case for your system, please upgrade to at least kernel version 2.4.22 and try again. If you are already running a 2.4.22 or higher kernel, please read further for instructions for other possible courses of action.

Here is another example, this time featuring a Back-UPS 350:

```
T:  Bus=01 Lev=01 Prnt=01 Port=00 Cnt=01 Dev#=  2 Spd=1.5 MxCh= 0
D:  Ver= 1.10 Cls=00(>ifc ) Sub=00 Prot=00 MxPS= 8 #Cfgs=  1
P:  Vendor=051d ProdID=0002 Rev= 1.00
S:  Manufacturer=American Power Conversion
S:  Product=Back-UPS 350 FW: 5.2.I USB FW: c1
S:  SerialNumber=BB0115017954
C:* #Ifs= 1 Cfg#= 1 Atr=a0 MxPwr= 30mA
I:  If#= 0 Alt= 0 #EPs= 1 Cls=03(HID  ) Sub=00 Prot=00 Driver=hid
E:  Ad=81(I) Atr=03(Int.) MxPS=   8 Ivl= 10ms
```

In general, if you see your UPS model in the `S:` field, which means `Manufacturer=`, `Product=`, and `SerialNumber=`, and you see `Driver=hid` in the `I:` field, you know the UPS has been recognized and is bound to the correct driver.

If your UPS doesn't appear in the list at all, check the obvious things: The UPS must be powered on, and a cable must be properly seated in both the data port of the UPS and one of your machine's USB ports. Many UPSes have phone ports to provide surge protection for phones or modems -- make sure you haven't plugged your USB cable into one of those rather than the data port (which will usually be near the top edge of the case.)

Also, ensure that the correct drivers are loaded. Under Linux-2.4.x, you can check this out easily by examining the /proc/bus/usb/drivers file. Here's how you can do that:

```
cat /proc/bus/usb/drivers
```

...and you should get:

```
        usbdevfs
        hub
96-111: hiddev
        hid
```

On Linux-2.6.x, make sure the sysfs filesystem is mounted on /sys and do:

```
ls -l /sys/bus/usb/drivers/
```

...where you should get:

```
total 0
drwxr-xr-x    2 root     root            0 May  1 18:55 hid
drwxr-xr-x    2 root     root            0 May  1 18:55 hiddev
drwxr-xr-x    2 root     root            0 May  1 18:55 hub
drwxr-xr-x    2 root     root            0 May  1 18:55 usb
drwxr-xr-x    2 root     root            0 May  1 18:55 usbfs
```

...or perhaps something like:

```
total 0
drwxr-xr-x  2 root root 0 Jan  6 15:27 hiddev
drwxr-xr-x  2 root root 0 Jan  6 15:28 hub
drwxr-xr-x  2 root root 0 Jan  6 15:28 usb
drwxr-xr-x  2 root root 0 Jan  6 15:27 usbfs
drwxr-xr-x  2 root root 0 Jan  6 15:28 usbhid
```

If your 2.6.x system does not have the /sys/bus/usb directory, either you do not have sysfs mounted on /sys or the USB module(s) have not been loaded. (Check /proc/mounts to make sure sysfs is mounted.)

A USB UPS needs all of these drivers -- the USB device filesystem, the USB hub, the Human Interface Device subsystem driver, and the Human Interface Device driver. If you are compiling your own kernel, you want to enable

```
CONFIG_USB
CONFIG_USB_HID
CONFIG_USB_HIDDEV
CONFIG_USB_DEVICEFS
```

...as well as at least one USB Host Controller Driver...

```
CONFIG_USB_UHCI_HCD (linux-2.6.x)
CONFIG_USB_OHCI_HCD (linux-2.6.x)
CONFIG_USB_UHCI     (linux-2.4.x)
CONFIG_USB_OHCI     (linux-2.4.x)
```

Device Nodes

Apcupsd accesses USB UPSes via the hiddev device nodes. Typically these are located in `/dev/hiddevN`, `/dev/usb/hiddevN` or `/dev/usb/hiddev/hiddevN` (where `N` is a digit 0 thru 9). Some distributions (some Debian releases, possibly others) do not provides these device nodes for you, so you will have to make them yourself. Check `/dev`, `/dev/usb`, and `/dev/usb/hiddev` and if you cannot find the `hiddevN` nodes, run (as root) the `examples/make-hiddev` script from the apcupsd source distribution.

Modern Linux distributions using the 2.6 kernel create device nodes dynamically on the fly as they are needed. It is basically a hotplug system, giving a lot more power to the user to determine what happens when a device is probed or opened. It is also a lot more complicated.

Some early 2.6 distributions (Fedora Core 3, for one) do not include hiddev rules in their default udev rule set. The bottom line for apcupsd on such a system is that if the `hiddevN` is not created when you plug in your UPS, apcupsd will terminate with an error. The solution to the problem is to add a rule to the udev rules file. On Fedora FC3, this file is found in `/etc/udev/rules.d/50-udev.rules`. Start by adding the following line:

```
BUS="usb", SYSFS{idVendor}="051d", NAME="usb/hiddev%n"
```

Note that this rule uses obsolete udev syntax and is specific to FC3 and other distributions of similar vintage.

Then either reboot your system, or unplug and replug your UPS and then restart apcupsd. At that point a `/dev/usb/hiddevN` node should appear and apcupsd should work fine.

If you have several UPSes or you just want to give your UPS a fixed name, you can use rules like the following:

```
KERNEL=="hiddev*", SYSFS{serial}=="JB0319033692", SYMLINK="ups0"
KERNEL=="hiddev*", SYSFS{serial}=="JB0320004845", SYMLINK="ups1"
```

Note that this rule uses udev syntax that is appropriate only for distros such as RHEL4 and FC4 and others of a similar vintage.

More recent distros such as FC15 should use something like this:

```
KERNEL=="hiddev*", ATTRS{manufacturer}=="American Power Conversion", ATTRS{serial}=="BB0100009999  ", OWNER="root", SYMLINK+="ups0"
```

Replace the serial number in quotes with the one that corresponds to your UPS. Then whenever you plug in your UPS a symlink called ups0, ups1, etc. will be created pointing to the correct hiddev node. This technique is highly recommended if you have more than one UPS connected to the same server since rearranging your USB cables or even upgrading the kernel can affect the order in which devices are detected and thus change which hiddev node corresponds to which UPS. If you use the symlink-by-serial-number approach the link will always point to the correct device node.

You can use...

```
udevinfo -a -p /sys/class/usb/hiddev0/
```

...to get more information on the fields that can be matched besides serial number.

To find the available attributes to match (note that the serial is NOT always the UPS serial on the box or in the USB connect message in /var/log/messages), use:

```
udevadm info --attribute-walk --name=/dev/usb/hiddev0
```

An additional device-node-related problem is the use of dynamic minors. Some distributions, such as Mandrake 10, ship with a kernel having `CONFIG_USB_DYNAMIC_MINORS` turned on. This is not ideal for running with apcupsd, and the easiest solution is to turn `CONFIG_USB_DYNAMIC_MINORS` off and rebuild your kernel, or find a pre-built kernel with it off. For a kernel with `CONFIG_USB_DYNAMIC_MINORS` turned on to work with apcupsd, you must enable `devfs`. The following will tell you if devfs is enabled:

```
$ ps ax | grep devs
```

...which should give something like the following:

```
533 ?        S      0:00 devfsd /dev
```

What complicates the situation much more on Mandrake kernels is their security level since `CONFIG_DYNAMIC_USB_MINORS` is turned on, but on higher security levels devfs is turned off. The net result, is that in those situations hiddev is completely unusable so apcupsd will not work. So, in these cases, the choices are:

1. Reduce the security level setting of the system (not sure if this is possible after the initial install).
2. Custom build a high security kernel with devfs enabled and make sure devfs is mounted and devfsd is running.
3. Custom build a high security kernel with dynamic minors disabled
4. Use udev

Miscellaneous

If all these things check out and you still can't see the UPS, something is more seriously wrong than this manual can cover -- find expert help. If you are unable to list USB devices or drivers, you kernel may not be USB-capable and that needs to be fixed.

BSD USB Configuration

Known BSD USB Issues

Problem

FreeBSD lockups: Some users have experienced lockups (apcupsd stops responding) on FreeBSD systems.

Solution

Recent versions of Apcupsd have addressed this issue. Please upgrade to apcupsd-3.10.18 or higher.

Problem

FreeBSD kernel panics if USB cable is unplugged while apcupsd is running.

Solution

This is a kernel bug and is most easily worked around by not hot- unplugging the UPS while apcupsd is running. This issue may be fixed in recent FreeBSD kernels.

Platforms and Versions

The *BSD USB driver supports FreeBSD, OpenBSD and NetBSD. (Thanks go to the *BSD developers who kept a nearly identical interface across all three platforms.)

Kernel Configuration

Users of OpenBSD, NetBSD, and some versions of FreeBSD will need to rebuild the kernel in order to *enable the ugen driver* and *disable the uhid driver*. uhid is not sufficient for apcupsd at this time and we need to prevent it from grabbing the UPS device. You should *make the following changes* to your kernel config file:

FreeBSD (v5.4 and below, v6.0)

(you **will not** lose use of USB keyboard and mouse)
Disable: uhid
Enable: ugen

FreeBSD (v5.5, v6.1 and above)

(you **will not** lose use of USB keyboard and mouse)
Disable: (nothing)

Enable: ugen
This is the default configuration for a GENERIC kernel on many platforms so you most likely will not need to recompile.

NetBSD (v3.x and below)

(you **will** lose use of USB keyboard and mouse)
Disable: uhidev, ums, wsmouse, ukbd, wskbd, uhid
Enable: ugen

NetBSD (v4.0 and above)

You can use apcupsd on single USB port without disabling the USB keyboard and mouse on other ports, though all other devices will be disabled on the port you pick for your UPS.
First, decide which hub and port you wish to use. You can find out the hub and port numbers for any particular physical connector by plugging a USB device into it and looking at the messages printed by the kernel; you should messages something like this:

```
uxx0 at uhub0 port 1
uxx0: <some device name>
```

To use your APC UPS on this port, configure the kernel to prefer attachment of the ugen driver over other drivers on this hub and port only, by adding a line like this to your kernel config file:

```
ugen*   at uhub0 port 1 flags 1
```

(The "flags 1" forces the ugen to attach instead of anything else detected there.)
Configure and build that kernel as per the references below, and your UPS will now attach as a ugen device when plugged into that port.
Don't forget to '`cd /dev`' and '`./MAKEDEV ugen1`' (and 2 and so on) if you have more than one generic usb device on your system.

OpenBSD

(you **will** lose use of USB keyboard and mouse):
Disable: uhidev, ums, wsmouse, ukbd, wskbd, uhid
Enable: ugen

For detailed information on rebuilding your kernel, consult these references:

FreeBSD

http://www.freebsd.org/doc/en_US.ISO8859-1/books/handbook/kernelconfig.html

NetBSD

http://www.netbsd.org/guide/en/chap-kernel.html

OpenBSD

http://www.openbsd.org/faq/faq5.html#Building

Verifying Device Detection and Driver

After building a properly configured kernel, reboot into that kernel and plug in your UPS USB cable. You should see a dmesg log message like the following:

```
ugen0: American Power Conversion Back-UPS RS 1500 FW:8.g6 .D USB FW:g6, rev 1.10/1.06, addr 2
```

Note that the `ugen` driver is called out. If you see `uhid` instead, it probably means you did not properly disable the uhid driver when you compiled your kernel or perhaps you're not running the new kernel.

You can also check with '`usbdevs -d`' to get a list of USB devices recognized by the system as well as the drivers they are associated with. For example:

```
# usbdevs -d
addr 1: UHCI root hub, VIA
  uhub0
 addr 2: Back-UPS RS 1500 FW:8.g6 .D USB FW:g6, American Power Conversion
   ugen0
```

Device Nodes

Apcupsd communicates with the UPS through the USB generic device, `ugen`. You may or may not need to manually make `ugen` device nodes in `/dev`, depending on what OS you are using.

FreeBSD

No manual intervention needed. FreeBSD automatically creates the ugen nodes on demand.

NetBSD

By default, NetBSD only creates nodes for the first ugen device, `ugen0`. Check `usbdevs -d` to see which device your UPS was bound to and then create the appropriate node by running '`cd /dev ; ./MAKEDEV ugenN`', where `ugenN` is the ugen device name shown by `usbdevs`. It is probably a good idea to create several sets of ugen nodes in case you add more USB devices.

OpenBSD

Similar to NetBSD, OpenBSD creates nodes for `ugen0` and `ugen1`. Check `usbdevs -d` to see which device your UPS was bound to and then create the appropriate node by running '`cd /dev ; ./MAKEDEV ugenN`', where `ugenN` is the ugen device name shown by `usbdevs`. It is probably a good idea to create several sets of ugen nodes in case you add more USB devices.

Windows USB Configuration

Platforms and Versions

Apcupsd supports USB UPSes on Windows XP and newer, including 64 bit systems.

USB Driver Installation

USB connected UPSes on Windows require a special driver. In most cases, this driver is automatically installed when you install Apcupsd. However in some cases you may need to install the driver manually. For detailed instructions, please see the `install.txt` file located in the driver folder of your Apcupsd install.

Verifying Device Detection and Driver

After installing Apcupsd (and the Apcupsd USB driver, if necessary), plug in your UPS USB cable and open the Windows Device Manager. You should see a `American Power Conversion USB UPS (Apcupsd)` listed under the `Batteries` section. If a device of that name does not appear, check that your UPS is powered on and that the USB cable is connected at both ends. Reinstall the driver as directed above if needed.

Solaris USB Configuration

Platforms and Versions

Apcupsd supports USB UPSes on Solaris 10 and higher. Both x86 and SPARC platforms are supported.

Building Apcupsd with USB

Some specific packages are necessary when building Apcupsd with USB support on Solaris. You must install the `SUNWlibusb` and `SUNWlibusbugen` packages **BEFORE** attempting to build Apcupsd. These packages can be found on the Solaris installation CDROMs and should be installed with the `pkgadd` utility.

You also should build using the gcc compiler and ccs make, not Sun's compiler. The appropriate make utility can be found in `/usr/ccs/bin`. gcc can be installed from packages included on the Solaris installation CDROMs.

Configure and build Apcupsd normally, as described in Building and Installing Apcupsd. Be sure to include the `--enable-usb` flag to `configure`.

After building, install Apcupsd as root using '`make install`', then *perform a reconfigure boot* ('`reboot -- -r`'). During installation, Apcupsd will automatically configure your USB subsystem to attach APC USB devices to the `ugen` driver. This is a critical step and must be completed by a reconfigure boot. Note that the USB config changes will be reversed if you remove Apcupsd using '`make uninstall`'.

Verifying Device Detection and Driver

After installing Apcupsd as described above and performing a reconfigure boot, plug in your UPS USB cable. You should see a series of dmesg log messages similar to the following:

```
Dec  5 17:50:50 sunblade usba: [ID 912658 kern.info] USB 1.10 device (usb51d,2) operating at low speed (USB 1.x) on USB 1.10 root hub: input@4, ugen0 at bus address 3
Dec  5 17:50:50 sunblade usba: [ID 349649 kern.info]    American Power Conversion Smart-UPS 1000 FW:600.1.D USB FW:1.2 AS0127232356
Dec  5 17:50:50 sunblade genunix: [ID 936769 kern.info] ugen0 is /pci@1f,0/usb@c,3/input@4
Dec  5 17:50:50 sunblade genunix: [ID 408114 kern.info] /pci@1f,0/usb@c,3/input@4 (ugen0) online
```

Note that the `ugen` driver is called out. If you do not see any dmesg entries related to your UPS, ensure that it is turned on and that the USB cable is connected at both ends. Also verify that you installed Apcupsd as root using the '`make install`' command and that you performed a reconfigure boot afterward.

Device Nodes

Apcupsd communicates with the UPS through the USB generic device, `ugen`. The reconfigure boot performed after Apcupsd installation will ensure the correct device nodes are created. Once your UPS has been recognized in dmesg as shown above, you can check /dev/usb to see if the device nodes have appeared:

```
[user@sunblade /]$ ls /dev/usb/51d.2/*
cntrl0      cntrl0stat  devstat     if0in1      if0in1stat
```

(`51d.2` is the vendor/product id for APC UPSes.)

Mac OS X (Darwin) USB Configuration

Platforms and Versions

Apcupsd supports USB UPSes on Mac OS X (Darwin) 10.4.x and higher. Both Intel and PowerPC platforms are supported.

Building Apcupsd with USB

Some specific packages are necessary when building Apcupsd with USB support on Darwin. You must install libusb-0.1.12 which can be obtained from MacPorts (http://www.macports.org) (formerly DarwinPorts) or Fink (http://fink.sourceforge.net) or downloaded and built by hand (http://www.libusb.org). *You must not use libusb-1.x or higher (apcupsd does not support the new 1.0 APIs) nor any version earlier than 0.1.12 (earlier versions have a bug that apcupsd triggers). Generally that means you must use exactly 0.1.12.* Note that Apcupsd is sensitive to the install location of libusb, so beware if you change it from the default.

Apcupsd should be built using gcc, preferably from the XCode development tools. Currently the maintainer is using gcc-4.0.1 from XCode 2.4. Other versions of gcc from other sources may also work.

Configure and build Apcupsd normally, as described in Building and Installing Apcupsd. Be sure to include the `--enable-usb` flag to `configure`.

After building, install Apcupsd as root using '`make install`' and then reboot. During installation, Apcupsd will automatically install a simple dummy kext driver designed to prevent Apple's monitoring software from taking over the UPS. It is necessary to reboot in order to activate the kext. Note that this kext will be automatically removed if you uninstall Apcupsd using '`make uninstall`', allowing Apple's monitoring tool to once again access the UPS.

Verifying Device Detection and Driver

After installing Apcupsd as described above and rebooting, plug in your UPS USB cable. You should notice that Darwin does **NOT** display the battery monitor tool in the menu bar. You can also check Apple Menu -> About This Mac -> More Info... -> USB to ensure that your UPS appears in the list of USB devices.

Building and Installing apcupsd

In general it is recommended to obtain a prebuilt binary package for your platform. Given how apcupsd must integrate into the shutdown mechanism of the operating system and the rate at which such mechanisms are changed by vendors, the platform ports in the apcupsd tree may become out of date. In some cases, binary packages are provided by the apcupsd team (RedHat, Mandriva, SuSE, Windows, Mac OS X). For other platforms it is recommended to check your vendor's package repository and third party repositories for recent binary packages before resorting to building apcupsd from scratch. Note that some vendors continue to distribute *ancient* versions of apcupsd with known defects. These packages should **not** be used.

Installation from Binary Packages

RPMS

For systems based on RPM packages, such as Red Hat and SuSE, apcupsd is available in binary RPM format. This is the simplest way to install. If you have no previous version of apcupsd on your machine and are creating a standalone configuration, simply install the RPM with a normal '`rpm -ihv`' command. You're done, and can now skip the rest of this chapter and go straight to tweaking your run-time configuration file. (see After Installation)

If you have a previous installation, you can upgrade with a normal '`rpm -Uhv`', but this may not upgrade the halt script. It may be better to do the upgrade as a remove '`rpm -e`' followed by a fresh install '`rpm -ihv`'.

After installation of the binary RPM, please verify carefully that /etc/rc.d/init.d/halt was properly updated and contains new script lines flagged with `***APCUPSD***`.

Since there is no standard location for cgi-bin, the rpm will place the binary CGI programs in the directory /etc/apcupsd/cgi. To actually use them, you must copy or move them to your actual cgi-bin directory, which on many systems is located in /home/httpd/cgi-bin.

Microsoft Windows

The Windows version of apcupsd is distributed as a simple double-click installer. Installation is very simple and straight-forward: Simply double-click the installer executable and follow the instructions. See The Windows Version of apcupsd for further details.

Installation from Source

Installation from source might have to be be done different ways depending on what system you are running. The basic procedure involves getting a source distribution, running the configuration, rebuilding, and installing.

For building the system, we suggest that you run the configure and make processes as your normal UNIX user ID. The '`make install`' must be run as root. But if your normal ID has an environment setup for using the C compiler, it's simpler to do that than to set up root to have the correct environment.

apcupsd requires `gcc` and `g++` compilers as well as GNU `make`. Other compilers or BSD `make` will **not** work. GNU make is sometimes installed as `gmake`. The configure script will check for this and will inform you of what command to use to invoke GNU make.

The basic installation from a tar source file is rather simple:

1. Unpack the source code from its tar archive.
2. Go into the directory containing the source code.
3. Run '`./configure`' (with appropriate options as described below)
4. '`make`' or '`gmake`'' as instructed by configure
5. '`su`' (i.e. become root)
6. Stop any running instance of apcupsd. The command to do this will look like '`system-dependent-path/apcupsd stop`'
7. uninstall any old apcupsd This is important since the default install locations may have changed.
8. '`make install`' or '`gmake install`'
9. edit your /etc/apcupsd/apcupsd.conf file if necessary
10. ensure that your halt script is properly updated
11. Start the new apcupsd with: '`system-dependent-path/apcupsd start`'

If all goes well, the '`./configure`' will correctly determine which operating system you are running and configure the source code appropriately. `configure` currently recognizes the systems listed below in the Operating System Specifics section of this chapter and adapts the configuration appropriately. Check that the configuration report printed at the end of the `configure` process corresponds to your choice of directories, options, and that it has correctly detected your operating system. If not, redo the `configure` with the appropriate options until your configuration is correct.

Please note that a number of the `configure` options preset apcupsd.conf directive values in an attempt to automatically adapt apcupsd as best possible to your system. You can change the values in apcupsd.conf at a later time without redoing the configuration process by simply editing the apcupsd.conf file.

Other configuration options can be used to set up the installation of HTML documentation and optional modules, notably the CGI interface that enables the UPS state to be queried via the Web. You will find a complete reference later in this chapter.

In general, you will probably want to supply a more elaborate `configure` statement to ensure that the modules you want are built and that everything is placed into the correct directories.

On Red Hat, a fairly typical configuration command would look like the following:

```
CFLAGS="-g -O2" LDFLAGS="-g" ./configure \
  --enable-usb \
  --with-upstype=usb \
  --with-upscable=usb \
  --prefix=/usr \
  --sbindir=/sbin \
  --with-cgi-bin=/var/www/cgi-bin \
  --enable-cgi \
  --with-log-dir=/etc/apcupsd
```

By default, '`make install`' will install the executable files in /sbin, the manuals in /usr/man, and the configuration and script files in /etc/apcupsd. In addition, if your system is recognized, certain files such as the startup script and the system halt script will be placed in appropriate system directories (usually subdirectories of /etc/rc.d).

Verifying a Source Installation

There are a number of things that you can do to check if the installation (make install) went well. The fist is to check where the system has installed apcupsd using '`which`' and '`whereis`'. On my Red Hat system, you should get the following (lines preceded with a $ indicate what you type):

```
$ which apcupsd
/sbin/apcupsd
$ whereis apcupsd
apcupsd: /sbin/apcupsd /etc/apcupsd /etc/apcupsd.conf
/etc/apcupsd.status /usr/man/man8/apcupsd.8.gz
/usr/man/man8/apcupsd.8
```

If you find an apcupsd in /usr/sbin, /usr/local/sbin, /usr/lib, or another such directory, it is probably a piece of an old version of apcupsd that you can delete. If you are in doubt, delete it, then rerun the '`make install`' to ensure that you haven't deleted anything needed by the new apcupsd. Please note that the files specified above assume the default installation locations.

As a final check that the '`make install`' went well, you should check your halt script (in /etc/rc.d on SUSE systems, and in /etc/rc.d/init.d on Red Hat systems) to see that the appropriate lines have been inserted in the correct place. Modification of the halt script is important so that at the end of the shutdown procedure, apcupsd will be called again to command the UPS to turn off the power. This should only be done in a power failure situation as indicated by the presence of the /etc/powerfail file, and is necessary if you want your machine to automatically be restarted when the power returns. On a Red Hat system, the lines containing the `# ***apcupsd***` should be inserted just before the final halt command:

```
# Remount read only anything that's left mounted.
#echo "Remounting remaining filesystems (if any) readonly"
mount | awk '/ext2/ { print $3 }' | while read line; do
    mount -n -o ro,remount $line
done

# See if this is a powerfail situation.                                  # ***apcupsd***
if [ -f /etc/apcupsd/powerfail ]; then                                   # ***apcupsd***
   echo                                                                  # ***apcupsd***
   echo "APCUPSD will now power off the UPS"                             # ***apcupsd***
   echo                                                                  # ***apcupsd***
   /etc/apcupsd/apccontrol killpower                                     # ***apcupsd***
   echo                                                                  # ***apcupsd***
   echo "Please ensure that the UPS has powered off before rebooting"    # ***apcupsd***
   echo "Otherwise, the UPS may cut the power during the reboot!!!"      # ***apcupsd***
   echo                                                                  # ***apcupsd***
fi                                                                       # ***apcupsd***

# Now halt or reboot.
echo "$message"
if [ -f /fastboot ]; then
 echo "On the next boot fsck will be skipped."
elif [ -f /forcefsck ]; then
 echo "On the next boot fsck will be forced."
fi
```

The purpose of modifying the system halt files is so that apcupsd will be recalled after the system is in a stable state. At that point, apcupsd will instruct the UPS to shut off the power. This is necessary if you wish your system to automatically reboot when the mains power is restored. If you prefer to manually reboot your system, you can skip this final system dependent installation step by specifying the `disable-install-distdir` option on the '`./configure`' command (see below for more details).

The above pertains to Red Hat systems only. There are significant differences in the procedures on each system, as well as the location of the halt script. Also, the information that is inserted in your halt script

varies from system to system. Other systems such as Solaris require you the make the changes manually, which has the advantage that you won't have any unpleasant surprises in your halt script should things go wrong. Please consult the specific system dependent README files for more details.

Please note that if you install from RPMs for a slave machine, you will need to remove the changes that the RPM install script made (similar to what is noted above) to the halt script. This is because on a slave machine there is no connection to the UPS, so there is no need to attempt to power off the UPS. That will be done by the master.

Configure Options

All the available `configure` options can be printed by entering:

```
./configure --help
```

When specifying options for '`./configure`', if in doubt, don't put anything, since normally the configuration process will determine the proper settings for your system. The advantage of these options is that it permits you to customize your version of apcupsd. If you save the '`./configure`' command that you use to create apcupsd, you can quickly reset the same customization in the next version of apcupsd by simply re-using the same command.

The following command line options are available for `configure` to customize your installation.

`--prefix=path`	This defines the directory for the non-executable files such as the manuals. The default is /usr.
`--sbindir=path`	This defines the directory for the executable files such as apcupsd. The default is /sbin. You may be tempted to place the executable files in /usr/sbin or /usr/local/sbin. Please use caution here as these directories may be unmounted during a shutdown and thus may prevent the `halt` script from calling apcupsd to turn off the UPS power. Though your data will be protected, in this case, your system will probably not be automatically rebooted when the power returns
`--enable-cgi`	This enables the building of the CGI programs that permit Web browser access to apcupsd data. This option is not necessary for the proper execution of apcupsd.
`--with-cgi-bin=path`	The with-cgi-bin configuration option allows you to define the directory where the CGI programs will be installed. The default is /etc/apcupsd, which is probably not what you want.
`--enable-apcsmart`	Turns on generation of the APC Smart driver (default).
`--enable-dumb`	Turns on generation of the dumb signalling driver code (default).
`--enable-usb`	Turns on generation of the USB driver code. By default this is disabled.
`--enable-net`	Turns on generation of the NIS network driver for slaves. For each slave, this is the only driver needed. This driver works by reading the information from the the configured master using the NIS (Network Information Services) interface.

`--enable-snmp`	Turns on generation of the SNMP driver. This driver accesses the UPS over the network using SNMP. This is compatible only with UPSes equipped with an SNMP or Web/SNMP management card. By default this is enabled.
`--enable-net-snmp`	Turns on generation of the obsolete NET-SNMP driver. This driver was the precursor to the current snmp driver and is now obsolete. It is available as a fallback if the new driver cannot be used for some reason. By default this is disabled.
`--enable-pcnet`	Turns on generation of the PCNET (PowerChute Network Shutdown) driver. This driver accesses the UPS over the network using APC's custom protocol. This driver can be used as an alternative to SNMP for UPSes equipped with a modern Web/SNMP management card.
`--enable-modbus`	Turns on generation of the MODBUS/RS232 driver (default)
`--enable-modbus-usb`	Turns on generation of the MODBUS/USB driver
`--enable-test`	This turns on a test driver that is used only for debugging. By default it is disabled.
`--enable-gapcmon`	This option enables building the GTK GUI front-end for apcupsd. Building this package requires numerous GNOME libraries. The default is disabled.
`--enable-apcagent`	This option enables building the apcagent menubar application on Mac OS X platforms. The default is disabled.
`--with-libwrap=path, --with-libwrap`	This option when enabled causes apcupsd to be built with the TCP WRAPPER library for enhanced security. In most cases, the path is optional since configure will determine where the libraries are on most systems.
`--with-nologin=path`	This option allows you to specify where apcupsd will create the nologin file when logins are prohibited. The default is /etc
`--with-pid-dir=path`	This option allows you to specify where apcupsd will create the process id (PID) file to prevent multiple copies from running. The default is system dependent but usually /var/run.
`--with-log-dir=path`	This option allows you to specify where apcupsd will create the EVENTS and STATUS log files. The default is /etc/apcupsd. This option simply sets the default of the appropriate path in the apcupsd.conf file, which can be changed at any later time.
`--with-lock-dir=path`	This option allows you to specify where apcupsd will create the serial port lock file. The default is system-dependent but usually /var/lock. This option simply sets the appropriate path in the apcupsd.conf file, which can be changed at any later time.

`--with-pwrfail-dir=path`	This option allows you to specify where apcupsd will create the powerfail file when a power failure occurs. The default is system dependent but usually /etc.
`--with-serial-dev=device-name`	This option allows you to specify where apcupsd will look for the serial device that talks to the UPS. The default is system dependent, but often /dev/ttyS0. This option simply sets the appropriate device name in the apcupsd.conf file, which can be changed at any later time.
`--with-nis-port=port`	This option allows you to specify what port apcupsd will use for the Network Information Server (the CGI programs). The default is system dependent but usually 3551 because that port has been officially assigned to apcupsd by the IANA. This option simply sets the appropriate port in the apcupsd.conf file, which can be changed at any later time.
`--with-nisip=ip-address`	This option allows you to specify the value that will be placed on then NISIP directive in the configuration file. The default is 0.0.0.0. No checking is done on the value entered, so you must ensure that it is a valid IP address.
`--with-net-port=port`	This option allows you to specify what port apcupsd will use for Master and Slave communications. The default is system dependent but usually 6666. This option simply sets the appropriate port in the apcupsd.conf file, which can be changed at any later time.
`--with-upstype=type`	This option allows you to specify the type of UPS that will be connected to your computer. The default is: smartups. This option simply sets the appropriate UPS type in the apcupsd.conf file, which can be changed at any later time.
`--with-upscable=cable`	This option allows you to specify what cable you are using to connect to the UPS. The default is: smart. This option simply sets the appropriate UPS cable in the apcupsd.conf file, which can be changed at any later time.
`--disable-install-distdir`	This option modifies the apcupsd Makefiles disable installation of the distribution (platform) directory. Generally, this used to do a full installation of apcupsd except the final modification of the operating system files (normally /etc/rc.d/halt, etc.). This is useful if your operating system is not directly supported by apcupsd or if you want to run two copies of apcupsd on the same system. This option can also be used by those of you who prefer to manually reboot your system after a power failure or who do not want to modify your system halt files.

Recommended Options for most Systems

For most systems, we recommend the following options:

```
./configure --prefix=/usr --sbindir=/sbin --enable-usb
```

and you can optionally build and install the CGI programs as follows:

```
./configure --prefix=/usr --sbindir=/sbin --enable-usb \
            --enable-cgi --with-cgi-bin=/home/httpd/cgi-bin
```

Compilers and Options

Some systems require unusual options for compilation or linking that the '`./configure`' script does not know about. You can specify initial values for variables by setting them in the environment. Using a Bourne-compatible shell, you can do that on the command line like this:

```
CFLAGS="-O2 -Wall" LDFLAGS= ./configure
```

Or on systems that have the `env` program, you can do it like this:

```
env CPPFLAGS=-I/usr/local/include LDFLAGS=-s ./configure
```

Or for example on the Sun Solaris system, you can use:

```
setenv CFLAGS -O2
setenv LDFLAGS -O
./configure
```

You can get a listing of all available options by doing:

```
./configure --help
```

or simply see the previous section of this manual.

Operating System Specifics

With the exception of Linux SUSE and Linux Red Hat systems used by the developers, we rely on users to help create installation scripts and instructions as well as to test that apcupsd runs correctly on their system. As you can imagine, most of these people are system administrators rather than developers so they are very busy and don't always have time to test the latest releases. With that in mind, we believe that you will find that a lot of very valuable work has been already done to make your installation much easier (and probably totally automatic).

Below, you will find a list of operating systems for which we have received installation files:

- Debian (see Debian)
- FreeBSD (see FreeBSD)
- HPUX (see HPUX)
- NetBSD (see NetBSD)
- Mac OS X Darwin (see Mac OS X Darwin)
- OpenBSD (see OpenBSD)
- Red Hat (see Red Hat Systems)
- Slackware (see Slackware)

- SUSE (see SUSE)
- Solaris (see Sun Solaris)
- unknown (see Unknown System)
- Win32 (see Windows Systems)

Debian

This port is complete and is being used by several users. Since Debian build and install procedures are somewhat particular, we have put the extra Debian information into the following two subdirectories: `platforms/debian/examples` and `platforms/debian/packageinfo`

You can also find the official Debian packages on the Debian site at:

- https://packages.debian.org/stable/apcupsd
- https://packages.debian.org/testing/apcupsd
- https://packages.debian.org/unstable/apcupsd

FreeBSD

This port is complete and is being used by several users.

You will need to install and use GNU make (aka gmake) instead of the BSD make supplied with the system.

On the FreeBSD OS, there is no known way for a user program to get control when all the disks are synced. This is needed for apcupsd to be able to issue the killpower command to the UPS so that the UPS shuts off the power. To accomplish the same thing on FreeBSD systems, make sure you have a SmartUPS and that your UPS shutdown grace period is set sufficiently long so that you system will power down (usually 2 minutes), the use the `--kill-on-powerfail` option on the apcupsd command line.

HPUX

Status of this port is unknown.

NetBSD

You will need to install and use GNU make (aka gmake) instead of the BSD make supplied with the system.

Mac OS X Darwin

On OS X (Darwin), apcupsd can be built with `configure` defaults. The USB driver can be enabled, as per the directions on Mac OS X (Darwin) USB Configuration Apcupsd *may* be usable on OS X with a smart serial device, but certainly *does* work as a NIS client or using a USB interface.

The startup information will be installed in `/Library/StartupItems/apcupsd` which is part of darwin's SystemStartup.

OpenBSD

You will need to install and use GNU make (aka gmake) instead of the BSD make supplied with the system.

Ensure that you read the distributions/openbsd/README file before running apcupsd. There are some critical differences in how the OpenBSD implementation operates when the UPS batteries are exhausted. Failure to take this into account may result in the system not being fully halted when power is lost.

Red Hat Systems

Red Hat systems are fully supported, and by following the standard installation instructions given above, you should experience few or no problems.

Slackware

Slackware systems are fully supported, and by following the standard installation instructions given above, you should experience few or no problems.

SUSE

SUSE systems are fully supported, and by following the standard installation instructions given above, you should experience few or no problems.

Sun Solaris

Please read this before attempting to compile or install the beta software. It contains important information that will make your efforts easier.

Before running '`./configure`', please be sure that you do not have /usr/ucb on your path. This may cause the `configure` to choose the wrong shutdown program. If `configure` detects that /usr/usb is on your path, it will print a warning message. Please follow the advice to avoid shutdown problems.

Your normal UNIX user ID must own the source tree directories, and you must have the normal development tools in your path. This includes make, the compiler, the M4 preprocessor, the linker, and ar or ranlib. If the user you are logged in as can compile and link a C program from a source file, then you have all the required tools available.

You will want to install the executables in a directory that remains mounted during the shutdown. Solaris will unmount almost everything except the root directories. Since the ability to power the UPS off requires access to the executable programs, they need to be in a directory that will never be unmounted. And since they should also be in a directory that normal users cannot get into, /sbin is the default. However, please be aware that if you want to follow Sun's filesystem conventions you would use the following:

```
./configure \
   --prefix=/opt/apcupsd \
   --sbindir=/etc/opt/apcupsd/sbin \
   --sysconfdir=/etc/opt/apcupsd \
   --with-cgi-bin=/opt/apcupsd/cgi-bin
```

The way to setup the /sbin directory as the executables directory is to pass configure the `--sbindir=/sbin` option. No other arguments should be required, and your setup and platform should be detected automatically by configure.

Once you have run configure, you will need to do a '`gmake`'. Once the make has completed with no errors, you must su to root to complete the install. After the su, you may not have a path to the make program anymore. In that case, you should do the '`gmake install`' step as:

```
gmake install
```

Once the install completes, you must edit the /sbin/rc0 script as detailed below, then exit from the su'ed shell.

In order to support unattended operation and shutdown during a power failure, it's important that the UPS remove power after the shutdown completes. This allows the unattended UPS to reboot the system when power returns by re-powering the system. Of course, you need autoboot enabled for your system to do this, but all Solaris systems have this by default. If you have disabled this on your system, please re-enable it.

To get the UPS to remove power from the system at the correct time during shutdown, i.e., after the disks have done their final sync, we need to modify a system script. This script is /sbin/rc0.

We do not have access to every version of Solaris, but we believe this file will be almost identical on every version. Please let us know if this is not true.

At the very end of the /sbin/rc0 script, you should find lines just like the following:

```
# unmount file systems. /usr, /var and /var/adm are not unmounted by umountall
# because they are mounted by rcS (for single user mode) rather than
# mountall.
# If this is changed, mountall, umountall and rcS should also change.
/sbin/umountall
/sbin/umount /var/adm >/dev/null 2>\&1
/sbin/umount /var >/dev/null 2>\&1
/sbin/umount /usr >/dev/null 2>\&1

echo 'The system is down.'
```

We need to insert the following lines just before the last 'echo':

```
#see if this is a powerfail situation
if [ -f /etc/apcupsd/powerfail ]; then
        echo
        echo "APCUPSD will power off the UPS"
        echo
        /etc/apcupsd/apccontrol killpower
        echo
        echo "Please ensure that the UPS has powered off before rebooting"
        echo "Otherwise, the UPS may cut the power during the reboot!!!"
        echo
fi
```

We have included these lines in a file called rc0.solaris in the distributions/sun subdirectory of the source tree. You can cut and paste them into the /sbin/rc0 file at the correct place, or yank and put them using vi or any other editor. Note that you must be root to edit this file.

You must be absolutely sure you have them in the right place. If your /sbin/rc0 file does not look like the lines shown above, do not modify the file. Instead, email a copy of the file to the maintainers, and we will attempt to figure out what you should do. If you mess up this file, the system will not shut down cleanly, and you could lose data. Don't take the chance.

You will then need to make the normal changes to the /etc/apcupsd/apcupsd.conf file. This file contains the configuration settings for the package. It is important that you set the values to match your UPS model and cable type, and the serial port that you have attached the UPS to. People have used both /dev/ttya and /dev/ttyb with no problems. You should be sure that logins are disabled on the port you are going to use, otherwise you will not be able to communicate with the UPS. If you are not sure that logins are disabled for the port, run the 'admintool' program as root, and disable the port. The 'admintool' program is a GUI administration program, and required that you are running CDE, OpenWindows, or another XWindows program such as KDE.

Solaris probes the serial ports during boot, and during this process, it toggles some handshaking lines used by dumb UPSes. As a result, particularly for simple signalling "dumb" UPSes it seems to kick it into a mode that makes the UPS think it's either in a calibration run, or some self-test mode. Since at this point we are really not communicating with the UPS, it's pretty hard to tell what happened. But it's easy to prevent this, and you should. Disconnect the UPS, and boot the system. When you get to a login prompt, log in as root. Type the following command:

```
eeprom com1-noprobe=true
```

or

```
eeprom com2-noprobe=true
```

depending on which com port your UPS is attached to. Then sync and shutdown the system normally, reattach the UPS, and reboot. This should solve the problem. However, we have some reports that recent versions of Solaris (7 & 8) appear to have removed this eeprom option and there seems to be no way to suppress the serial port probing during boot.

At this point, you should have a complete installation. The daemon will load automatically at the next boot. Watch for any error messages during boot, and check the event logs in /etc/apcupsd. If everything looks OK, you can try testing the package by removing power from the UPS. NOTE! if you have a voltage-signalling UPS, please run the first power tests with your computer plugged into the wall rather than into the UPS. This is because dumb serial-port UPSes have a tendency to power off if your configuration or cable are not correct.

As a user, your input is very helpful in solving problems with the package, and providing suggestions and future directions for the development of the package. We are striving to provide a useful package that works across all platforms, and welcome your feedback.

Unknown System

During the '`./configure`', if apcupsd does not find one of the systems for which it has specific installation programs, it will set the Operating System to `unknown` and will use the incomplete installation scripts that are in `platforms/unknown`. You will be on your own, or you can ask the developers list (apcupsd-users@lists.sourceforge.net) for installation instructions. This directory also contains a hint file for Linux From Scratch, which could be helpful for other systems as well.

Windows Systems

Appropriate scripts (actually Windows batch files) are included with the Apcupsd Win32 installer package.

After Installation

Checking Your Configuration File

Once you have installed apcupsd, either from a binary package or by building from source, your next step should be to inspect your `/etc/apcupsd/apcupsd.conf` file to make sure it is valid.

You can read the complete reference on configuration directives (Configuration Directive Reference), but if you are setting up a normal standalone configuration you should only need to check (and possibly fix) the first three items listed below.

Your `UPSTYPE` should be the UPS's protocol type: dumb, apcsmart, usb, net, pcnet, or snmp. Your `UPSCABLE` should be the type of cable you are using.

`DEVICE` should be set to the path of the device node (usually in /dev) to use to communicate with the UPS. This is used primarily for serial port connections. If you have a USB device, it is better not to specify a `DEVICE` directive by leaving it black or commenting it out. Apcupsd will automatically search for your device in the standard places. If you specify a `DEVICE`, it should be the name of the device that apcupsd is to use to communicate with the UPS.

If the first time you execute apcupsd, you get a message to the effect that the Apcupsd USB driver is missing, it means that you most likely forgot to put `--enable-usb` on your '`./configure`' command line.

The Configuration Examples chapter of this manual provides the essential characteristics of each main type of configuration file. After those elements are correct, apcupsd should run, and then it is only a matter of customization of your setup.

Arranging for Reboot on Power-Up

The final consideration for a automatic reboot after a full power down is to ensure that your computer will automatically reboot when the power is restored.

This is not the normal behavior of most computers as shipped from the factory. Normally after the power is cut and restored, you must explicitly press a button for the power to actually be turned on. You can test your computer by powering it down; shutting off the power (pull the plug); then plugging the cord back in. If your computer immediately starts up, good. There is nothing more to do.

If your computer does not start up, manually turn on the power (by pressing the power on button) and enter your computer's SETUP program (often by pressing DEL during the power up sequence; sometimes by pressing F10). You must then find and change the appropriate configuration parameter to permit instant power on.

Normally, this is located under the `BOOT` menu item, and will be called something such as `Restore on AC/Power Loss` or `Full-On`. The exact words will vary according to the ROM BIOS provider. Generally you will have three options: `Last State`, `Power On`, and `Power Off`. Although `Last State` should normally work, we recommend setting your computers to `Power On`. This means that whenever the power is applied they are on. The only way to shut them off is to pull the plug or to have a special program that powers them off (/sbin/poweroff on Linux systems).

If after making all the changes suggested above, you cannot get your computer to automatically reboot, you might examine your halt script (/etc/rc.d/init.d/halt in the case of Red Hat Linux) and see if the final line that performs the halt or reboot contains the `-p` option for powering down the computer. It should not with the logic used by apcupsd, but if it does, the `-p` option could cause your computer to power off while the UPS is still suppling power (i.e. before the UPS kills the power). Depending on the setting of your BIOS, it may prevent your computer from restarting when the power returns. As already mentioned, this should not apply, but in case of problems it is worth a try.

Making sure apcupsd Is Running

The simplest way to invoke apcupsd is from the command line by entering:

```
/sbin/apcupsd
```

To do so, you must be root. However, normally, you will want apcupsd started automatically when your system boots. On some systems with installation support (e.g. SUSE and Red Hat), the installation procedure will create a script file that you will be automatically invoked when your system reboots. On other systems, you will have to invoke apcupsd from your rc.local script.

On Red Hat systems, this script file that automatically invokes apcupsd on system start and stops is `/etc/rc.d/init.d/apcupsd`

To start apcupsd manually (as you will probably do immediately following the installation), enter the following:

```
/etc/rc.d/init.d/apcupsd start
```

To understand how this file is automatically invoked at system startup and shutdown, see the man pages for `chkconfig(8)`.

On SUSE systems, the script file that automatically invokes apcupsd on system start and stops is `/etc/rc.d/apcupsd`.

To start apcupsd manually (as you will probably do immediately following the installation), enter the following:

```
/etc/rc.d/apcupsd start
```

Normally, when properly installed, apcupsd will be started and stopped automatically by your system. Unfortunately, the details are different for each system. Below, we give the commands for selected systems. Alternatively, there are simple stopapcupsd and startapcupsd scripts in the examples directory, or you can modify one of the scripts in the distributions directory to meet your needs.

To stop apcupsd you can do the following:

On Red Hat systems:

```
/etc/rc.d/init.d/apcupsd stop
```

On SUSE systems:

```
/etc/rc.d/apcupsd stop
```

Please see the Testing Apcupsd chapter for more details on insuring that apcupsd is running properly.

Configuration Examples

A Simple USB Configuration

If you have a USB UPS, the essential elements of your apcupsd.conf file should look like the following:

```
## apcupsd.conf v1.1 ##
UPSCABLE usb
UPSTYPE usb
DEVICE
LOCKFILE /var/lock
UPSCLASS standalone
UPSMODE disable
```

Notice that we have not specified a device. In doing so, apcupsd will try all the well known USB ports. We strongly recommend you use this (empty device address) form unless you have a good reason to do otherwise.

Please use the explicit specifications of a device only if you know exactly what you are doing. In general, it is much easier to let apcupsd find the device itself.

Please see USB Configuration for detailed help on setting up your system to work with a USB UPS.

A Simple Configuration for a Serial SmartUPS

If you have a Smart UPS using the serial cable supplied by APC, or you build a CUSTOM SMART cable outlined in the cables chapter, a very simple configuration file would look like the following:

```
## apcupsd.conf v1.1 ##
UPSCABLE smart
UPSTYPE apcsmart
DEVICE /dev/ttyS0
LOCKFILE /var/lock
UPSCLASS standalone
UPSMODE disable
```

Normally you would have many more configuration directives to completely customize your installation, but this example shows you the minimum required.

A Simple Configuration for a Simple Signaling or Dumb

If you have a simple signaling or dumb UPS such as a BackUPS, you will need to know exactly what cable you have and specify it on the UPSCABLE directive. Please see the list of UPSes versus cables in the beginning of this document for more information. The cable number is normally stamped in the plastic at one end of the cable. If you specify the wrong cable, it is very likely that at the first power failure, your

computer will be immediately shutdown. This is an unfortunate consequence of the dumb signaling mode. To avoid this, first replace /etc/apcupsd/apccontrol with safe.apccontrol found in the examples directory, then test until everything works correctly. Once you have the correct cable, be sure to remember to reinstall the correct apccontrol file and test that your computer is correctly shutdown during a power failure.

```
## apcupsd.conf v1.1 ##
UPSCABLE (number of cable you have)
UPSTYPE dumb
DEVICE /dev/ttyS0
LOCKFILE /var/lock
UPSCLASS standalone
UPSMODE disable
```

If your cable does not have low battery detection, as is the case with some older models, you will also need to define `TIMEOUT nnn` where you set `nn` to be the number of seconds on a power failure after which a shutdown is effected.

Normally you would have many more configuration directives to completely customize your installation, but this example shows you the minimum required.

NIS Server/Client Configuration Using the Net Driver

NIS (Network Information Server) mode allows for communication between instances of apcupsd running on different hosts. Only one of those hosts, the server, needs to talk to the UPS directly. The others, clients, obtain information about the state of the UPS by querying the server. NIS is *not* related to Sun's NIS/YP services.

NIS clients and servers require that apcupsd be compiled with the Net Driver `--enable-net`. This is typically enabled by default.

The NIS server is connected to the UPS and should be configured exactly as a standalone configuration, but with `NETSERVER on`. In all other respects, the server should be configured in standalone mode. You may also set the NIS server specific options `NISIP` to restrict which IP address of the server which apcupsd listens on. The default, 0.0.0.0, means to list on all of the server host's IP addresses; `NISPORT` (default 3551) to set which TCP port the server listens on; and `EVENTSFILE` and `EVENTSFILEMAX` to provide information about the last few events to clients. You may also need to modify your firewall rules on the server's host to allow traffic to the `NISPORT`.

For the NIS client computer, you will have a configuration that looks something like what follows. What is important is that you get the information from an `UPSCABLE ether` with `UPSTYPE net` over the network and you must specify the address of a NIS server using `DEVICE`. The client apcupsd will then poll the NIS server specified in `DEVICE` every `POLLTIME` seconds (formerly `NETTIME`).

```
## apcupsd.conf v1.1 ##
UPSCABLE ether
UPSTYPE net
LOCKFILE /var/lock
DEVICE server-network-address:3551
UPSCLASS standalone
UPSMODE disable
POLLTIME 10
```

The `DEVICE` is set to `server-address:port`, where `server-address` is the fully qualified domain name or IP address of the apcupsd NIS server, and `port` is the `NISPORT` that the server is listening on. The default is 3551, but older versions of apcupsd used port 7000.

If you set `POLLTIME` too large, your client may not see the change in state of the NIS server before the server has shutdown. Normally, you have at least 30 seconds of grace time between the time the NIS

server decides to shutdown and the time it no longer responds. Your slave must poll during this interval.

Any client run using the Net driver will shutdown when its own timers expire or when the NIS server shuts down, whichever occurs first. This means that if you want the slave to shutdown before the server, you need only set `BATTERYLEVEL`, `MINUTES` or `TIMEOUT` on the client for a faster shutdown than the values defined on the NIS server. This can often be useful if the slave is less important than the master and you wish to reduce battery power consumption so that the master can remain up longer during a power outage.

NIS clients work principally by reading the STATFLAG record that is sent by the NIS server (present in the output of apcaccess). The low 16 bits are the standard APC status flag, and the upper 16 bits represent the internal state of apcupsd, so the slave can see when the power fails and know when to shutdown.

It would be possible to have a client also work as a server, but that would increase the delay of information getting from the UPS to the secondary client.

Differences between NIS Client/Server and the old (now removed) Master/Slave modes

The difference between the NIS mode and the removed master/slave mode is that the NIS server has no explicit knowledge of the slaves. The NIS server makes its information available via the net (NIS), and the NIS slaves read it. When the NIS server is going to shutdown, it makes the information available to any NIS slave that polls it, but the NIS server does not explicitly call each NIS slave as is the case in the Master/Slave networking described several sections above.

Think of the difference as push (Master/Slave) vs. pull (NIS-based). In the case of M/S, the master makes all the shutdown decisions and notifies the slaves when they are to shut down or when some other interesting event happens. The slaves just do whatever the master says, whenever the master says to. On the other hand, with the NIS-based network config you basically "publish" the UPS status from one server and then your clients view that status and make their own decisions.

PowerChute Network Shutdown Driver (PCNET)

As of 3.14, Apcupsd supports the PowerChute Network Shutdown protocol. This is an alternative to SNMP for use with APC's AP9617 family of network smartslot modules. Note that the older AP9606 modules do **not** support PCNET.

To enable PCNET support, configure with the `--enable-pcnet` flag. This is typically enabled by default.

The required apcupsd.conf settings are straightforward:

```
## apcupsd.conf v1.1 ##
UPSCABLE ether
UPSTYPE pcnet
LOCKFILE /var/lock
DEVICE ipaddr:user:passphrase
UPSCLASS standalone
UPSMODE disable
```

The `DEVICE` setting specifies the IP address of the UPS as well as the username and authentication passphrase to use. Note that the username and passphrase are **not** the Web/SNMP login credentials. They are separate settings. The default username on a new card is "`apc`" and the default passphrase is "`admin user phrase`". To change the passphrase, log in to the Web UI and go to the UPS tab, then to PowerChute -> Configuration. (This assumes firmware v3.3.1. Other versions may place the setting elsewhere.) *The password must be a minimum of 15 characters long.* The web UI will silently ignore shorter passwords and does not give an error message. There is no apparent way to change the username.

Note that you may leave `DEVICE` blank and Apcupsd will accept information from any PCNET UPS on the network, **however it will be very insecure since an attacker could easily send packets crafted to cause your server to shut down**. Using the `ipaddr`, `user`, and `passphrase` will prevent this

behavior.

You may need to take steps to ensure networking stays active during your OS's shutdown sequence in order for the PCNET driver to power off the UPS (the so-called "killpower" operation). On a Linux distro, you can use commands such as...

```
chkconfig --level 0 network on
chkconfig --level 0 iptables on
```

...to make sure networking stays up.

MODBUS Driver

MODBUS is APC's replacement for the aging 'apcsmart' (aka UPS-Link) protocol. It is recommended for modern (ex: SMT series) Smart-UPS models. As of 3.14.11, apcupsd supports the MODBUS protocol over RS232 serial interfaces. As of 3.14.13, apcupsd supports the MODBUS protocol over USB.

Not all APC UPSes support MODBUS. New 2013 year Smart-UPS models are likely to support it out-of-the-box and firmware updates are available for some older models. APC/Schneider tech support is your best point of contact for determining if a certain model will support MODBUS. That said, APC knowledge base article FA164737 indicates MODBUS support is available for the majority of the SMC, SMT, and SMX model lines.

The required apcupsd.conf settings for MODBUS are straightforward.

For MODBUS serial RS232:

```
## apcupsd.conf v1.1 ##
UPSCABLE smart
UPSTYPE modbus
DEVICE /dev/ttyS0
LOCKFILE /var/lock
UPSCLASS standalone
UPSMODE disable
```

The `DEVICE` setting identifies the serial port to which the UPS is connected. This can take the form of `COM1`, etc. on Windows or `/dev/XXX` on UNIX systems.

You should use the APC-supplied serial cable (P/N 940-0625A) that ships with the UPS. Other 'smart' type cables may work, but only 940-0625A has been formally tested at this time.

For MODBUS USB:

```
## apcupsd.conf v1.1 ##
UPSCABLE usb
UPSTYPE modbus
DEVICE
LOCKFILE /var/lock
UPSCLASS standalone
UPSMODE disable
```

The `DEVICE` setting can be left blank or, optionally, set to the serial number of the UPS. If `DEVICE` is blank, apcupsd will attach to the first APC UPS it finds, otherwise it will attach to the specific UPS identified by the serial number.

Note that *most UPSes ship with MODBUS support disabled by default*. You must use the UPS's front panel menu to enable MODBUS protocol support before apcupsd will be able to communicate with the UPS. You may need to enable the "Advanced" menu option before the MODBUS protocol option will be visible.

Testing Apcupsd

The following testing procedures apply for the most part to SmartUPSes, whether USB or serial. If you have a dumb voltage-signalling UPS, your testing procedures will be somewhat different, and you should see the section on Testing Serial UPSes (see Testing Serial-Line UPSes).

Process-Status Test

After you start apcupsd, execute the following command:

```
ps fax
```

or the equivalent for your system. You should see something similar to the following output.

```
632 ?        S      0:00 /sbin/apcupsd -f /etc/apcupsd/apcupsd.conf
841 ?        S      0:00  \_ /sbin/apcupsd -f /etc/apcupsd/apcupsd.conf
842 ?        S      0:00      \_ /sbin/apcupsd -f /etc/apcupsd/apcupsd.conf
```

This indicates that apcupsd is up and running and has started the two standard threads in addition to the main thread.

If you see only one instance of apcupsd running, don't worry about it as this is normal on most non-Linux systems, and on Linux 2.6.x kernels.

If you do not find that apcupsd is in the above list, the most likely problem is a configuration file glitch. If no messages were printed, you should check your system log (normally `/var/log/messages`) where you will find one or messages indicating the nature of the problem.

Logging Test

Once you have established that the proper processes are running, do a tail of the system log file, normally `/var/log/messages`:

```
tail /var/log/messages
```

You should see output that looks similar to the following:

```
Dec 5 17:01:05 matou apcupsd[5917]: apcupsd 3.7.2 startup succeeded
```

These messages should also appear in the temporary file (`/etc/apcupsd/apcupsd.events`) if you are using the default configuration file. If you have installed the RPM, they will probably be in `/var/log/apcupsd.events`.

apcaccess Test

This test consists of running `apcaccess` to see if apcupsd is properly updating its internal variables. Please note that you must enable the apcupsd Network Information Server in your configuration file for `apcaccess` to work. This is done by setting:

```
NETSERVER on
NISPORT 3551
```

in your `apcupsd.conf` file.

To run the apcaccess test, use the following command:

```
apcaccess status
```

Depending on the type of UPS you have, you will get slightly different output, but an example For a Smart-UPS is as follows:

```
APC      : 001,048,1088
DATE     : Fri Dec 03 16:49:24 EST 1999
HOSTNAME : daughter
RELEASE  : 3.7.2
CABLE    : APC Cable 940-0024C
MODEL    : APC Smart-UPS 600
UPSMODE  : Stand Alone
UPSNAME  : SU600
LINEV    : 122.1 Volts
MAXLINEV : 123.3 Volts
MINLINEV : 122.1 Volts
LINEFREQ : 60.0 Hz
OUTPUTV  : 122.1 Volts
LOADPCT  :  32.7 Percent Load Capacity
BATTV    : 26.6 Volts
BCHARGE  : 095.0 Percent
MBATTCHG : 15 Percent
TIMELEFT :  19.0 Minutes
MINTIMEL : 3 Minutes
SENSE    : Medium
DWAKE    : 000 Seconds
DSHUTD   : 020 Seconds
LOTRANS  : 106.0 Volts
HITRANS  : 129.0 Volts
RETPCT   : 010.0 Percent
STATFLAG : 0x08 Status Flag
STATUS   : ONLINE
ITEMP    : 34.6 C Internal
ALARMDEL : Low Battery
LASTXFER : Unacceptable Utility Voltage Change
SELFTEST : NO
STESTI   : 336
DLOWBATT : 05 Minutes
DIPSW    : 0x00 Dip Switch
REG1     : N/A
REG2     : N/A
REG3     : 0x00 Register 3
MANDATE  : 03/30/95
SERIALNO : 13035861
BATTDATE : 05/05/98
NOMOUTV  : 115.0
NOMBATTV :  24.0
HUMIDITY : N/A
AMBTEMP  : N/A
EXTBATTS : N/A
BADBATTS : N/A
FIRMWARE : N/A
APCMODEL : 6TD
END APC  : Fri Dec 03 16:49:25 EST 1999
```

For a simple signaling or dumb UPS such as BackUPS, your output will be very minimal as follows:

```
APC      : 001,012,0319
DATE     : Mon Feb 18 09:11:50 CST 2002
RELEASE  : 3.8.5
UPSNAME  : UPS_IDEN
CABLE    : APC Cable 940-0128A
MODEL    : BackUPS
UPSMODE  : Stand Alone
STARTTIME: Mon Feb 18 09:11:45 CST 2002
LINEFAIL : OK
BATTSTAT : OK
STATFLAG : 0x008 Status Flag
END APC  : Mon Feb 18 09:15:01 CST 2002
```

If you see the above output, it is a good sign that apcupsd is working. Assuming that the output looks reasonable, check the following variables:

`LINEV`

This is the line voltage and it should be a value that is appropriate for your equipment. In the USA, it is typically about 120 Volts while in Europe, it is about 220 Volts.

`BATTV`

Unless you have additional battery packs, this should be near 24 Volts plus or minus 5 Volts.

`STATUS`

This is the status of the UPS and it should normally be `ONLINE`.

A very disturbing tendance is for some of the newer (Mar 2004) RS and ES UPSes to have no Voltage information. This is an annoying bug, but not serious. On the other hand, some of those UPSes now have no battery charge information `BCHARGE`. If `BCHARGE` is zero in your listing and you are running a Smart or a USB UPS, then you will have to set the `BATTERYLEVEL` directive in your apcupsd.conf file to -1.

If you see a message to the effect of:

```
APCACCESS FATAL ERROR in apcaccess.c at line 336
tcp_open: cannot connect to server localhost on port 3551.
```

It means that you have probably not enabled the Network Information Server in your configuration file for `apcaccess` to work. This is done by setting `NETSERVER` and `NISPORT` in your apcupsd.conf file as shown above.

Communications Test

At this point, you should ensure that apcupsd is handling the connection to the UPS correctly. This test assumes you have a UPS that speaks apcsmart protocol, over either USB or a serial port. If you have an old-style voltage-signaling UPS, please skip to the next section (Simulated Power Fail Test).

When apcupsd detects a problem, it generates an EVENT, which consists of sending a message to the system log then invoking the `apccontrol` script (normally in /etc/acpupsd/apccontrol) to handle the event.

In order to create an event, remove the serial port plug from the back of your computer or from the back of the UPS. Within 6 seconds, apcupsd should detect the lack of serial port communications and broadcast a `wall` message indicating that the serial port communications was lost:

```
Warning communications lost with UPS lost.
```

At the same time, it sends the same message to the system log and to the temporary EVENTS file (`/etc/apcupsd/apcupsd.events`).

Plug the serial port plug back into your computer, and within about 12 seconds, apcupsd should reestablish communications and broadcast and log the following message:

```
Communications with UPS restored.
```

If these messages are logged but not broadcast, either you have your `mesg` permission set to `no` (see '`man wall`' or '`man mesg`'), or there is a problem with apccontrol. If you are running a window manager such as GNOME and don't have a console window open, you may not receive the `wall` messages. However, you should find them in your system log file (normally `/var/log/messages`) and in the temporary EVENTS file, `/etc/apcupsd/apcupsd.events`. For example, to observe these events in the temporary EVENTS file, you might do a

```
tail -f /etc/apcupsd/apcupsd.events
```

Note, if you have installed from the RPM, the proper events file may be `/var/log/apcupsd.events`. You can find the actual filename by checking your apcupsd.conf file before running the test.

If you do not observe these messages, you should correct this problem before proceeding with additional tests.

Simulated Power Fail Test

At this point, you should verify that in the event of a power fail apcupsd properly calls apccontrol. This test is appropriate for all models of UPSes (smart or dumb).

To avoid the possibility that apcupsd might shut down your system, locate where apccontrol resides on your system (normally, /etc/apcupsd/apccontrol. Move this script to another location e.g. apccontrol.save and replace it with the script found in examples/safe.apccontrol. When that is done, ensure that your UPS battery is fully charged and that you have at least 5 minutes of remaining runtime on the batteries. This can be done by examining the values of the `BATTCHG` and `TIMELEFT` variables in the printout of '`apcaccess status`'.

Athough this should not be necessary, as an extra precaution, you can shutdown your machine, remove the plug from the UPS you are testing, and plug your machine into another UPS or directly into the wall. Doing so, will ensure that the UPS doesn't cut the power to your machine at a bad time. Remember at the end of the testing to plug your machine back into the UPS.

You can also minimize the risk from an unexpected shutdown by using a journaling filesystem such as Linux's EXT3. All modern disk drives park themselves safely when they power down, rather than ploughing up oxide on your disk's recording surface. Thus, unexpected power less has to hit very narrow timing windows in order to trash an EXT3 transaction.

To begin the test, pull the power plug from the UPS. The first time that you do this, psychologically it won't be easy, but after you have pulled the plug a few times, you may even come to enjoy it. If all goes well, apcupsd should detect the power failure and print several warning messages. The first should appear after 5 to 6 seconds and read:

```
Warning power loss detected.
```

Then generally 6 seconds later, apcupsd is sure that it isn't a transient effect, so it sends:

```
Power failure. Running on UPS batteries.
```

After a few more seconds (total around 15 seconds), plug the power cord back in and ensure that apcupsd is aware that the power has returned. It should print:

```
Power has returned...
```

If you do not observe the above messages, please correct the situation before proceeding. The most likely cause of problems are:

- apcupsd doesn't recognize the power failure because the configuration directives are not correct. E.g. wrong cable.
- The file `/etc/apcupsd/apccontrol` doesn't exist or is not marked as executable.

System Shutdown Test

This is an intermediate test that you can do, for all UPS models before doing the Full Power Down Test. First modify the `/etc/apcupsd/apccontrol` file so that in the `killpower` case, the line that re-executes apcupsd with the `--killpower` option is commented out. The original line probably looks something like:

```
${APCUPSD} --killpower
```

when it is commented out, it looks like:

```
#${APCUPSD} --killpower
```

Now when you pull the power plug, and either the timer expires or the batteries are exhausted (see the next section for more details), the system should be fully shutdown.

After performing this test, please be sure to restore `/etc/apcupsd/apccontrol` to its previous state.

Full Power Down Test

To complete the testing, you should do a power fail shutdown of your system. This test is applicable to all UPS models. Please do a backup of your system or take other precautions before attempting this to avoid the possibility of lost data due to a problem (I have been through this at least 10 times and never once had problems, but we all know that someday something will go wrong).

Before proceeding, please ensure that your halt script or the equivalent has been properly updated by the install process to contain the logic to call `apcupsd --killpower` or `apccontrol killpower` when it detects a power failure situation (the presence of a /etc/powerfail file). See the Building and Installing apcupsd section of this manual, or the README files for additional details about the halt modifications necessary.

When you are ready to do the test, either simply pull the plug and wait for the batteries to become exhausted, or set the `TIMEOUT` configuration directive to something like 60 so that the system will shutdown before the batteries are exhausted. We recommend doing the full shutdown without using `TIMEOUT` to correctly simulate a real power failure, but the choice is yours (I did it once here, but now use `TIMEOUT 30`).

If all goes well, your system should be shutdown before the batteries are completely exhausted and the UPS should be powered off by apcupsd. Please be aware that if you do the full power down, you must ensure that your UPS is totally powered off. Otherwise, it may have been given the command to power off, but due to a long grace period it is still waiting. If you were to reboot your computer during the grace period, the UPS could then suddenly turn off the power (this happened to me). To avoid this problem, always wait for your UPS to power itself off, or power if off manually before restarting your computer. On my system, the UPS is configured as at the factory to have a 180 second grace period before shutting off the power. During this type of testing, 180 seconds *seems* like an eternity, so please take care to either wait or manually power off your UPS. To determine what grace period is programmed into your UPS EEPROM, run '`apcaccess eprom`' and look at the "Shutdown grace delay".

If you experienced so problems with the above testing procedures, or if you are porting apcupsd to another system, or you are simply curious, you may want to know exactly what is going on during the shutdown process. If so, please see the Shutdown Sequence section of this manual.

apctest

`apctest` is a program that allows you to talk directly to your UPS and run certain low-level tests, adjust various settings such as the battery installation date and alarm behavior, and perform a battery runtime calibration. Here we describe how to use it for a SmartUPS utilizing the apcsmart driver and RS232 serial connection. The menus and options for USB, MODBUS, and simple signaling UPSes are different but mostly self-explanatory.

Shutdown apcupsd if it is running. This is important. Only one program can communicate with the UPS at a time and if apcupsd is running, apctest will fail to contact the UPS.

Run apctest by invoking it with no arguments.

It will read your installed apcupsd.conf configuration (so it knows where to find the UPS) and then it will present you with the following output:

```
2003-07-07 11:19:21 apctest 3.10.6 (07 July 2003) redhat
Checking configuration ...
Attached to driver: apcsmart
sharenet.type = DISABLE
cable.type = CUSTOM_SMART

You are using a SMART cable type, so I'm entering SMART test mode
mode.type = SMART
Setting up serial port ...
Creating serial port lock file ...
Hello, this is the apcupsd Cable Test program.
This part of apctest is for testing Smart UPSes.
Please select the function you want to perform.

1) Query the UPS for all known values
2) Perform a Battery Runtime Calibration
3) Abort Battery Calibration
4) Monitor Battery Calibration progress
5) Program EEPROM
6) Enter TTY mode communicating with UPS
7) Quit

Select function number: 1
```

Item 1 will probe the UPS for all values known to apcupsd and present them in rather raw format. This output can be useful for providing technical support if you are having problems with your UPS.

Item 2 will perform a Battery Runtime Calibration. This test will only be performed if your battery is 100% charged. Running the test will cause the batteries to be discharged to approximately 30% of capacity. The exact number depends on the UPS model. In any case, apctest will abort the test if it detects that the battery charge is 20% or less.

The advantage of doing this test is that the UPS will be able to recalibrate the remaining runtime counter that it maintains in its firmware. As your batteries age, they tend to hold less of a charge, so the runtime calibration may not be accurate after several years.

We recommend that perform a Battery Calibration about once a year. You should not perform this calibration too often since discharging the batteries tends to shorten their lifespan.

Item 3 can be used to abort a Battery Calibration in progress, if you some how became disconnected.

Item 4 can be used to restart the monitoring of a Battery Calibration if you should some how become disconnected during the test.

Item 5 is used to program the EEPROM. Please see the Configuration Directives Used to Set the UPS EEPROM chapter of this manual for the details.

Item 6 will initiate a direct communication between your terminal and the UPS, at which point you can enter raw UPS commands. Please be aware that you should be careful what commands you enter because you can cause your UPS to suddenly shutdown, or you can modify the EEPROM in a way to disable your UPS. The details of the raw Smart mode UPS commands can be found in the APC Smart Protocol chapter of this manual.

Item 7 will terminate apctest.

Monitoring and Tuning your UPS

After you have verified that your UPS is working correctly, you will probably want to query the state of its health occasionally. The tools apcupsd gives you to do this include one command-line utility (apcaccess) and a GUI you can use through a Web browser. You can also use apctest to tune some parameters of the UPS itself.

apcaccess

`apcaccess` is a program (normally found in `/sbin/apcaccess`) that permits you to print out the complete status of your UPS.

apcaccess will use the Network Information Server to obtain the necessary information. You can specify a second optional argument to apcaccess in the form of `host:port` where the `:port` is optional. The default is `localhost:3551`. Please note that in versions prior to 3.10.6, the default NIS port was 7000, so if you are mixing versions, you will need to take a lot of care to ensure that all components are using the same port.

To enable the apcupsd Network Information Server, which is normally the default, you set:

```
NETSERVER on
NISPORT 3551
```

in your `apcupsd.conf` file.

The full form of the apcaccess command is:

```
apcaccess status localhost:3551
```

where only apcaccess status should normally be needed. localhost may be replaced by any machine name, fully qualified domain name, or IP address, which means that apcaccess can access any UPS on the network running the Network Information Server.

The `status` command line option of apcaccess will produce a full printout of all the STATUS variables used by apcupsd. This can be very helpful for checking the condition of your UPS and to know whether or not apcupsd is properly connected to it.

Please note that if you invoke apcaccess within the first 30 seconds of launching apcupsd, you will likely get an error message such as:

```
APCACCESS FATAL ERROR in apcaccess.c at line 336
tcp_open: cannot connect to server localhost on port 3551.
```

This is because apcupsd is still in the process of initializing the UPS. The solution is to wait at least 30 seconds after starting apcupsd before launching apcaccess.

For a SmartUPS 1000 apcaccess will emit the following output:

```
DATE     : Fri Dec 03 12:34:26 CET 1999
HOSTNAME : matou
RELEASE  : 3.7.0-beta-1
CABLE    : Custom Cable Smart
MODEL    : SMART-UPS 1000
UPSMODE  : Stand Alone
UPSNAME  : UPS_IDEN
LINEV    : 232.7 Volts
MAXLINEV : 236.6 Volts
MINLINEV : 231.4 Volts
LINEFREQ : 50.0 Hz
OUTPUTV  : 232.7 Volts
LOADPCT  :  11.4 Percent Load Capacity
BATTV    : 27.7 Volts
BCHARGE  : 100.0 Percent
MBATTCHG : 5 Percent
TIMELEFT : 112.0 Minutes
MINTIMEL : 3 Minutes
SENSE    : Low
DWAKE    : 060 Seconds
DSHUTD   : 180 Seconds
LOTRANS  : 204.0 Volts
HITRANS  : 253.0 Volts
RETPCT   : 050.0 Percent
STATFLAG : 0x08 Status Flag
STATUS   : ONLINE
ITEMP    : 29.2 C Internal
ALARMDEL : Low Battery
LASTXFER : U command or Self Test
SELFTEST : NO
STESTI   : 336
DLOWBATT : 02 Minutes
DIPSW    : 0x00 Dip Switch
REG1     : 0x00 Register 1
REG2     : 0x00 Register 2
REG3     : 0x00 Register 3
MANDATE  : 01/05/99
SERIALNO : GS9902009459
BATTDATE : 01/05/99
NOMOUTV  : 230.0
NOMBATTV :  24.0
HUMIDITY : N/A
AMBTEMP  : N/A
EXTBATTS : 0
BADBATTS : N/A
FIRMWARE : 60.11.I
APCMODEL : IWI
END APC  : Fri Dec 03 12:34:33 CET 1999
```

For the various smaller, cheaper APC USB UPSes, such as the CS, ES, ..., you will get much of the information that is presented above, but not all of it. For example, you will not get `MAXLINEV`, `MINLINEV`, `LINEFREQ`, ... and in particular, the LOADPCT will be zero when you are running on mains. `LOADPCT` will display when the UPS is on batteries. You must remember that the non-SmartUPSes are much simpler (and less expensive) and therefore produce less information.

Apcupsd Notification and Events

When a major event is generated within apcupsd, control is passed to the script apccontrol normally found in /etc/apcupsd/apccontrol. The event name, and a number of other important parameters are passed to the script.

The major function of the apccontrol script is to perform a shutdown of the system (as well as the killpower operation). In addition, another major task for this script is to notify you by email when certain events such as powerfail occur.

Since apccontrol is a script, you can customize it to your own needs using any text editor. To do so, you must have a minimal knowledge of Unix shell programming. In addition, another feature is that you can write your own scripts that will be automatically called by apccontrol before any of its own code is executed. Details of the events and how to program them are contained in the Advanced topics section entitled Customizing Event Handling.

apcupsd Network Monitoring (CGI) Programs

There are four CGI programs (multimon.cgi, upsstats.cgi, upsfstats.cgi, and upsimage.cgi). To have them properly installed, you must run the '`./configure`' command with `--enable-cgi` and you should specify an installation directory with `--with-cgi-bin=` or load them manually. The default directory for installation of the CGI programs is `/etc/apcupsd`, which is not really where you want them if you are going to use them. Normally, they should go in the cgi-bin of your Web server.

Once built and loaded, they will give you the status of your UPS or UPSes via a web browser.

Normally only `multimon.cgi` is directly invoked by the user. However, it is possible to directly invoke `upsstats.cgi` and `upsfstats.cgi`. `upsimage.cgi` should never be directly invoked as it is used by `upsstats.cgi` to produce the bar charts.

Setting up and Testing the CGI Programs

Before using multimon and the other CGI programs, first ensure that apcupsd is configured to run the Network Information Server. This is done by setting `NETSERVER on` in /etc/apcupsd/apcupsd.conf. This switch is on by default.

Next you must edit the hosts file /etc/apcupsd/hosts.conf and at the end, add the name of the hosts you want to monitor and a label string for them. For example:

```
MONITOR matou "Server"
MONITOR polymatou "Backup server"
MONITOR deuter  "Disk server"
```

matou, polymatou, and deuter are the network names of the three machines currently running apcupsd. Please note that the network names may either be IP addresses or fully qualified domain names. The network name (or IP address) may optionally be followed by `:port`, where the port is the NIS port address you wish to use. This is useful if you are running multiple copies of apcupsd on the same system or if you are running in a mixed vendor environment where the NIS port assignments differ. An example could be the following:

```
MONITOR matou "Server"
MONITOR polymatou "Backup server"
MONITOR deuter  "Disk server"
MONITOR polymatou:7001 "APC USB UPS"
```

where the USB copy of apcupsd has been configured to use port 7001 by modifying apcupsd.conf. Note, the default NIS port is 3551 on most platforms.

To test multimon.cgi, you can execute it as non-root directly from the source cgi build directory. To do so, enter at a shell prompt:

```
./multimon.cgi
```

If everything is set up correctly, it will print a bunch of HTML with the values of the machines that you have put in the hosts.conf file. It should look something like the following (note, only a small portion of the output is reproduced here):

```
Content-type: text/html

<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN"
     "http://www.w3.org/TR/REC-html40/loose.dtd">
<HTML>
<HEAD><TITLE>Multimon: UPS Status Page</TITLE></HEAD>
<BODY BGCOLOR="#FFFFFF">
<TABLE BGCOLOR="#50A0A0" ALIGN=CENTER>
<TR><TD>
<TABLE CELLPADDING=5>
<TR>
<TH COLSPAN=10 BGCOLOR="#60B0B0">
<FONT SIZE="+2">APCUPSD UPS Network Monitor</FONT>
<BR>Sun Jan 16 12:07:27 CET 2000</TH>
</TR>
<TR BGCOLOR="#60B0B0">
<TH COLSPAN=1>System</TH>
<TH COLSPAN=1>Model</TH>
<TH COLSPAN=1>Status</TH>
...
```

If you do not get similar output, check the permissions of the /etc/apcupsd directory and of those of /etc/apcupsd/hosts.conf to ensure that your web server can access it. At many sites, the Apache server is not running as root, so you must be careful to ensure that that /etc/apcupsd/hosts.conf and /etc/apcupsd/multimon.conf are world readable.

To invoke multimon in your Web browser, enter:

`http://your-site/cgi-bin/multimon.cgi`

You should get something similar to the screen shot shown below.

If you wish additional control over the colors, type faces, and sizes of the multimon output, you may simply edit the apcupsd.css file to specify the styles you prefer.

Using the CGI Programs on Windows

The CGI programs compiled for Windows are included in the Windows package starting with apcupsd-3.14.7.

The CGI programs included with the Windows package are intended to be run on Windows. If your web server is running on Linux or another operating system, you will need to obtain binary packages for that platform (or build them from source) instead. The windows build of the CGI programs has been tested with the Apache web server for Win32. They should also work with MS Internet Information Server (IIS).

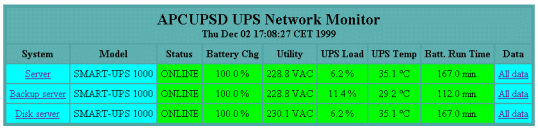
To use the programs, copy the contents of the `cgi/` directory from your apcupsd installation directory to the `cgi-bin/` directory of your web server. Consult your web server's documentation for how to enable CGI programs to be executed. Sometimes special security settings are required.

Configure the hosts.conf file as described above. The programs expect to find the `hosts.conf` file and the `apcupsd.css` file in the directory `\apcupsd\etc\apcupsd` on the same drive letter as the web server's `cgi-bin` directory. If you installed apcupsd into `C:\apcupsd` (the default) and your web server's `cgi-bin/` directory is also located on the `C:` drive, no further changes are necessary. If you installed apcupsd into a different directory or your web server `cgi-bin` is on another drive, you will need

to relocate `hosts.conf` and `apcupsd.css` from the apcupsd install location to `\apcupsd\etc\apcupsd` on the appropriate drive.

multimon.cgi

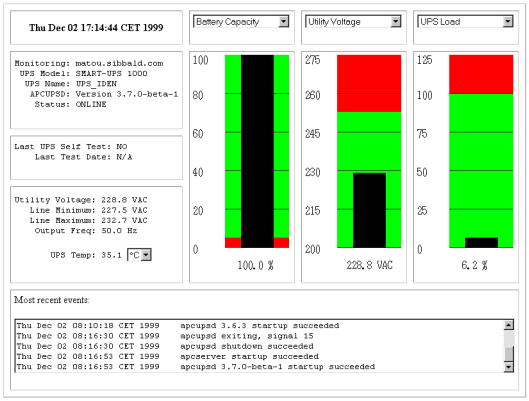
This program monitors multiple UPSes at the same time. A typical output of multimon.cgi as displayed in your Web browser might look like the following:


APCUPSD UPS Network Monitor
Thu Dec 02 17:08:27 CET 1999
System Model Status Battery Chg Utility UPS Load UPS Temp Batt. Run Time Data
Server SMART-UPS 1000 ONLINE 100.0 % 228.8 VAC 6.2 % 35.1 °C 167.0 min. All data
Backup server SMART-UPS 1000 ONLINE 100.0 % 228.8 VAC 11.4 % 29.2 °C 112.0 min. All data
Disk server SMART-UPS 1000 ONLINE 100.0 % 230.1 VAC 6.2 % 35.1 °C 167.0 min. All data

The machines monitored as well as the values and their column headings are all configurable (see /etc/apcupsd/hosts.conf and /etc/apcupsd/multimon.conf)

upsstats.cgi

By clicking on the `system` name in the multimon.cgi display, you will invoke upsstats.cgi for the specified system, which will produce a bar graph display of three of the monitored values. For example,


Thu Dec 02 17:14:44 CET 1999
Battery Capacity
Utility Voltage
UPS Load
Monitoring: matou.sibbald.com
UPS Model: SMART-UPS 1000
UPS Name: UPS_IDEN
APCUPSD: Version 3.7.0-beta-1
Status: ONLINE
Last UPS Self Test: NO
Last Test Date: N/A
Utility Voltage: 228.8 VAC
Line Minimum: 227.5 VAC
Line Maximum: 232.7 VAC
Output Freq: 50.0 Hz
UPS Temp: 35.1 °C
100.0 %
228.8 VAC
6.2 %
Most recent events:
Thu Dec 02 08:10:18 CET 1999 apcupsd 3.6.3 startup succeeded
Thu Dec 02 08:16:30 CET 1999 apcupsd exiting, signal 15
Thu Dec 02 08:16:30 CET 1999 apcupsd shutdown succeeded
Thu Dec 02 08:16:53 CET 1999 apcserver startup succeeded
Thu Dec 02 08:16:53 CET 1999 apcupsd 3.7.0-beta-1 startup succeeded

You can display different bar graphs by selecting different variables from the drop down menus at the top of each of the three bar graphs.

As with multimon, if you have your local host configured in the /etc/apcupsd/hosts.conf file, you can execute it from a Unix shell from the source cgi directory as follows:

```
./upsstats.cgi
```

As with multimon, quite a few lines of html should then be displayed.

upsfstatus.cgi

If you would like to see all of the STATUS variables available over the network, click on the `Data` field of the desired system, and your browser will display something like the following:

```
APC      : 001,048,1109
DATE     : Thu Dec 02 17:27:21 CET 1999
HOSTNAME : matou.sibbald.com
RELEASE  : 3.7.0-beta-1
CABLE    : Custom Cable Smart
MODEL    : SMART-UPS 1000
UPSMODE  : Stand Alone
UPSNAME  : UPS_IDEN
LINEV    : 223.6 Volts
MAXLINEV : 224.9 Volts
MINLINEV : 222.3 Volts
```

```
LINEFREQ : 50.0 Hz
OUTPUTV  : 223.6 Volts
LOADPCT  :   6.2 Percent Load Capacity
BATTV    : 27.9 Volts
BCHARGE  : 100.0 Percent
MBATTCHG : 5 Percent
TIMELEFT : 167.0 Minutes
MINTIMEL : 3 Minutes
SENSE    : High
DWAKE    : 060 Seconds
DSHUTD   : 020 Seconds
LOTRANS  : 196.0 Volts
HITRANS  : 253.0 Volts
RETPCT   : 050.0 Percent
STATFLAG : 0x08 Status Flag
STATUS   : ONLINE
ITEMP    : 35.1 C Internal
ALARMDEL : Low Battery
LASTXFER : U command or Self Test
SELFTEST : NO
STESTI   : 336
DLOWBATT : 02 Minutes
DIPSW    : 0x00 Dip Switch
REG1     : 0x00 Register 1
REG2     : 0x00 Register 2
REG3     : 0x00 Register 3
MANDATE  : 01/11/99
SERIALNO : GS9903001147
BATTDATE : 01/11/99
NOMOUTV  : 230.0
NOMBATTV :  24.0
HUMIDITY : N/A
AMBTEMP  : N/A
EXTBATTS : 0
BADBATTS : N/A
FIRMWARE : 60.11.I
APCMODEL : IWI
END APC  : Thu Dec 02 17:27:25 CET 1999
```

You should get pretty much the same output mixed in with html if you execute upsfstats.cgi directly from a Unix shell in the cgi subdirectory as explained above for upsstats.cgi and multimon.cgi.

A Tip from Carl Erhorn for Sun Systems:

It is possible to run the CGI code to monitor your UPS using the answerbook HTTP server that runs on Solaris. As long as your server has the Answerbook2 web server installed and running, you can insert the cgi scripts into the cgi directory of the web server, and access the cgi using something like:

`http://hostname:8888/cgi/multimon.cgi`

CGI Credits

Many thanks go to Russell Kroll rkroll@exploits.org who wrote the CGI programs to work with his UPS Monitoring system named Network UPS Tools (NUT). Thanks also to Jonathan Benson jbenson@technologist.com for initially adapting the upsstatus.cgi program to work with apcupsd.

We have enhanced the bar graph program and hope that our changes can be useful to the original author in his project.

Security Issues:

- `apcupsd` runs as root.
- If you have `NETSERVER ON` in your apcupsd.conf file (which is the default), be aware that anyone on the network can read the status of your UPS. This may or may not pose a problem. If you don't consider this information privileged, as is the case for many, there is little risk. In addition, if you have a perimeter firewall or NATting router with typical settings only users on your local network access to your UPS information. You may also restrict access using using firewall settings (see below) or TCP Wrappers (see below).

Firewall Settings

If you are running apcupsd as an NIS server, you will need to ensure that the clients can reach it by opening up `NISPORT` (default: TCP 3551) on any firewall running on the server. You may wish to configure your firewall(s) to *only* allow connections from your local network or specifically from the masters, slaves, and servers as needed.

TCP Wrappers

If your operating system does not support a host based firewall (a firewall running on the local machine) then you may try to get some of the functionality of such a firewall with TCP Wrappers. As of apcupsd version 3.8.2, TCP Wrappers are implemented if you turn them on when configuring `./configure --with-libwrap`. With this code enabled, you may control who may access your apcupsd via TCP connections (the Network Information Server). This control is done by modifying the file: /etc/hosts.allow. This code is implemented but untested. If you use it, please send us some feedback.

Configuring Your EEPROM

If you have a SmartUPS, there are depending on the UPS at least 12 different values stored in the EEPROM that determine how the UPS reacts to various conditions such as high line voltage, low line voltage, power down grace periods, etc.

In general, for the moment, we do not recommend that you change your EEPROM values unless absolutely necessary. There have been several reported cases of problems setting the Low Transfer Voltage. Consequently, if at all possible, do not attempt to change this value.

Using apctest to Configure Your EEPROM

To make the EEPROM changes with apctest you must first stop the apcupsd daemon. After apcupsd is stopped you may invoke apctest (as root).

We recommend that you change the EEPROM as little as is absolutely necessary since it is a somewhat delicate process that has occasionally produced problems (i.e. improper EEPROM values are displayed after the update).

apctest will present a menu of options which are generally self-explanatory. Note that USB connections will show a difference set of options than smart serial connections.

Maintaining Your UPS Batteries

Battery Technology

Sealed Lead Acid (SLA) batteries, otherwise known as Valve Regulated Lead Acid (VRLA) batteries, were originally known as "dry batteries". When first introduced in the 1950s, they used a gel electrolyte. The otherwise free acid was immobilised with a fine silica powder and formed a gel substance.

In the 1970s the technology moved to Absorbed Glass Mat (AGM) where the separators between the lead plates are made of highly porous micro-fine glass fibres which absorb and immobilise the acid and prevent it from spilling. A crack or hole in the casing of a VRLA battery using AGM technology will not result in a measurable electrolyte spill. Spill containment with VRLA batteries is therefore not meaningful or

appropriate.

AGM has became the preferred VRLA technology for use in standby or float applications and is used in UPSes in the telecommunications, power, and many other mission critical industries where the power supply must not be interrupted. APC UPSes use VRLA batteries. VRLA batteries are designed to recombine hydrogen and oxygen and emit only extremely small amounts of hydrogen under normal operating conditions. Normal room ventilation is sufficient to remove any hydrogen, so special ventilation is not required.

Battery Life

Most brand name UPS batteries should last 3-5 years. Some APC Back-UPS models may have a shorter battery life expectancy. Refer to the user's manual of your APC Back-UPS to determine the exact battery life expectancy or contact APC Technical Support.

Below are some APC guidelines for ensuring optimum battery life expectancy:

1. Make sure that you keep your APC UPS in a cool, dry location with plenty of ventilation. Ideally, the temperature where your UPS is kept should not exceed 75 Deg F (24 Deg C). Also, for ventilation purposes, leave roughly one to two inches on each side for proper airflow.
2. The optimum operating temperature for a lead acid battery is 25 Deg C (77 Deg F). Elevated temperature reduces longevity. As a guideline, every 8 Deg C (15 Deg F) rise in temperature will cut the battery life in half. A battery which would last for 6 years at 25 Deg C (77 Deg F), will only be good for 3 years if operated at 33 Deg C (95 Deg F). Keep in mind that the battery temperature inside your UPS will always be warmer than the ambient temperature of the location where the UPS is installed.
3. Only perform runtime calibrations on your UPS one or two times a year, if necessary. Some of our customers want to check their systems to verify that their runtime is sufficient. However, consistently performing these calibrations can significantly decrease the life expectancy of your battery.
4. Do not store batteries for extended periods of time. New batteries can be stored for 6 to 12 months from date of purchase. After this period, the battery should be used or it will lose a great deal of its charge. It is not advisable to store batteries that have already been in use.
5. Do not exceed 80 percent of a UPS unit's rated capacity due to the reduction in run time. When you increase your load, your runtime decreases. In the event of a utility power failure, a UPS loaded to full capacity will drain and discharge it's battery quickly and will decrease the life expectancy.

The Smart-UPS detects line voltage distortions such as spikes, notches, dips, and swells, as well as distortions caused by operation with inexpensive fuel-powered generators. By default, the UPS reacts to distortions by transferring to on-battery operation to protect the equipment that you are plugging into the UPS. Where power quality is poor, the UPS may frequently transfer to on-battery operation. Battery longevity and service life of the UPS may be conserved by reducing the sensitivity of the UPS, as long as your equipment can operate normally under the conditions detailed below. Any type of voltage disturbance includes; High/Low/No RMS Voltage, Total Harmonic Distortion(THD), Change in Voltage over Time(dv/dt), Frequency (Hz) out of tolerance.

High Sensitivity Mode

In the event of any type of voltage disturbance, the UPS will transfer to battery power and watch the AC line until it can transfer back to line. The transfer time in this mode depends on how far the line voltage deviates from the sinewave reference.

Medium Sensitivity Mode

In the event of a RMS voltage-out-of-tolerance(High/Low/No) and RMS-rate-of-change disturbances(dv/dt) in the line voltage, the UPS will transfer to battery power and watch the AC line until it can transfer back to line. In this mode the transfer times are longer but still within acceptable limits to insure the continuity of a computer's operation.

Low Sensitivity Mode

In the event of a RMS voltage-out-of-tolerance disturbances(High/Low/No) in the line voltage, the UPS will transfer to battery power and watch the AC line until it can transfer back to line. In this mode the transfer times are longer but still within acceptable limits to insure the continuity of a computer's operation.

To change the sensitivity of the UPS, press the small, white "sensitivity" button on the rear of the UPS. Use a pointed object (such as a pen) to do so. The default setting is "high"; press the button once to set the sensitivity to "medium", and press it again to set it to "low"; pressing it a third time will set it back to "high". The sensitivity setting change will take effect immediately. The green LED next to the button is a sensitivity setting indicator - brightly lit is "high" sensitivity, dimly lit is "medium", and off is "low" sensitivity.

Flashing Battery Charge Graph LEDs

The battery charge graph LEDs on the front panel of a Smart-UPS will flash in unison when the UPS is operating online and the runtime remaining (calculated by the Smart-UPS microprocessor) is less than two minutes more than the low battery signal warning time (minimum of two minutes).

This would usually indicate that you need to either decrease the load or install new batteries. If the batteries are new, then you need to perform a runtime calibration (see below).

At a pinch, you could also decrease the low battery warning time. There are four possible settings: 2, 5, 7, or 10 minutes.

Battery Replacement

If you own your UPS for long enough, you will inevitably need to replace the UPS battery or battery cartridge. An APC battery cartridge comprises two batteries physically stuck together with double-sided tape and wired in series.

After the decision to replace the batteries, you will face another decision almost immediately: whether to purchase genuine APC replacement batteries or not. There are pros and cons to purchasing genuine replacement APC batteries.

APC Battery Pros

- APC batteries are supported by APC
- APC batteries come with all the necessary hardware
- APC batteries come as pre-made cartridges
- APC batteries will physically fit your UPS

APC Battery Cons

- APC batteries cost up to 4 times the cost of third party batteries

There are also pros and cons to purchasing third party batteries.

Third Party Battery Pros

- A third party battery may cost up to 1/4 the price of APC batteries
- A third party battery may have a higher capacity for the same physical size

Third Party Battery Cons

- You will need to recycle your battery hardware (cables, connectors etc)
- You will need to create your own battery cartridges (with double-sided tape)
- You will need to ensure the third party battery is the right physical size
- You will need to ensure the third party battery is the right capacity
- Use of a third party battery will void APC's Equipment Protection Policy

- Use of a third party battery may void UL, CSA, VDE, and other safety certifications (according to APC)

If you do decide to use third party replacement batteries, please do not choose the cheapest available generic SLA batteries. These batteries will, almost without exception, not last as long as brand name batteries and will need replacing within 12-18 months instead of 3-5 years. Even when using brand name replacement batteries, make sure that you choose the UPS version (aka "standby") which may cost slightly more, but which will last significantly longer in typical UPS usage (long periods of standby punctuated with infrequent deep discharges).

The brands of battery found in genuine APC battery cartridges have included: Panasonic and B&B Battery (aka Best & Best Battery and BB Battery). Yuasa (aka Genesis) is also a recommended brand, albeit a bit on the pricey side.

Note: When substituting a third party battery with a higher capacity than the original, make sure that it still physically fits in the UPS casing. If the battery does not fit, do not be tempted to install it "externally". The UPS may not be able to charge it in a timely manner and/or it may damage the UPS charging circuitry without appropriate modifications which are generally beyond an end user's capability.

Battery Installation

Although you can do a hot swap of your batteries while the computer and any other connected equipment is running, it may not be very satisfactory because the UPS will not always detect that the batteries have been swapped and apcupsd will continue to report "Low Battery".

There are several ways to correct this situation:

1. If you have a "smart" UPS model, you can force a self-test to make the UPS notice that the battery has been replaced.

2. If after a self-test, the UPS does not detect that the battery has been replaced, you can use apctest to do a soft battery runtime calibration. For details of doing this, refer to the "Soft" Runtime Calibration section below.

3. If after the soft battery runtime recalibration, the UPS does not detect that the battery has been replaced, you will need to do a manual battery runtime calibration. For details of doing this, refer to the "Manual" Runtime Calibration section below.

"Soft" Runtime Calibration

A runtime calibration causes the UPS to recalculate its available runtime capacity based on its current load.

Caution: a runtime calibration will deeply discharge the UPS batteries, which can leave a UPS temporarily unable to support its equipment if a utility power failure occurs. Frequent calibrations reduce the life of batteries. APC recommends performing a runtime calibration only annually, semiannually, or whenever the load on the UPS is increased.

In order to perform a "soft" runtime calibration it is necessary to wait for the UPS to recharge its batteries to 100% capacity. Once this has been done, you can then initiate a runtime calibration through apctest.

APC Documentation Notes:

1. In order for the calibration to be accurate, the output load has to be more than 40% (some APC documentation recommends at least 30%). Also, it is advisable not to increase or reduce the load when the UPS is calibrating its run time.

2. Under no circumstances should the UPS be turned off during a run time calibration procedure! Once initiated, the calibration must be allowed to run until completion.

3. The run time calibration procedure is not necessary nor advisable for a new UPS. Only old UPSes with batteries that are not subject to discharge for long periods of time should be allowed to perform a run time calibration.

4. Matrix-UPS and Smart-UPS recalculate the runtime-related parameters every time the UPS goes on battery.

When doing a runtime calibration with "older" batteries, APC Technical Support recommend doing a complete discharge and recharge first.

If you have "dumb" UPS (aka simple signalling) like a Back-UPS, then your only option is to do a manual runtime calibration.

"Manual" Runtime Calibration

Most of the information in this section is taken from APC's website. Any non-APC additions have been inserted in square brackets.

For a "smart" or "smart signalling" Back-UPS Pro or Smart-UPS:

> Perform a Runtime Calibration. This is a manual procedure and should not be confused with the runtime calibration performed through PowerChute plus [or apctest]. The batteries inside of the Smart-UPS are controlled by a microprocessor within the UPS. Sometimes it is necessary to reset this microprocessor, especially after the installation of new batteries. Stop the PowerChute plus [or apcupsd] software from running and disconnect the serial cable. There must be at least a 30% load attached to the UPS during this procedure, but the process will cause the UPS to shut off and cut power to its outlets. Therefore, attach a non-critical load to the UPS and then force the UPS on battery by disconnecting it from utility power [suggest not disconnecting, but simply turning off utility power thereby preserving earthing]. Allow the unit to run on battery until it turns off completely. Make sure a 30% load is present! Plug the UPS back into the wall outlet [switch utility power back on] and allow it to recharge (it will recharge more quickly turned off and with no load present). Once the unit has recharged, the "runtime remaining" calculation should be more accurate. Remember that if the unit is an older model, then the runtime will not improve significantly.
>
> Background:
>
> An APC Smart-UPS has a microprocessor which calculates runtime primarily based on the load attached to the UPS and on its battery capacity. On the right side of the front display panel there is a vertical graph of five LEDs. Each LED is an indication of battery charge in increments of twenty percent: 20, 40, 60, 80, 100% (bottom to top). For example, if the battery charge is 99%, then only four of the five LEDs are illuminated.
>
> To ensure that an operating system receives a graceful shutdown when using PowerChute plus or a SmartSlot accessory, an alert is generated by the Smart-UPS indicating that the UPS has reached a low battery condition. The alert is audible (rapid beeping), visual (flashing battery LED or LEDs), and readable through the graphical interface of PowerChute plus software (or a native UPS shutdown program within a particular operating system.) In order to calculate this "low battery condition," all Smart-UPS products have a preconfigured low battery signal warning time of two minutes (this is the factory default setting). There are a total of four user-changeable settings: 2, 5, 7, or 10 minutes. If the low battery signal warning time is set for 2 minutes, then the alerts will activate simultaneously two minutes prior to shutdown. Similarly, if the total runtime for a particular UPS is 30 minutes with a low battery signal warning time set at 10 minutes, then the UPS will run on battery for 20 minutes before the low battery alert begins.
>
> Total runtime is primarily based on two factors, battery capacity and UPS load. UPS load and runtime on battery are inversely proportional: as load increases, battery runtime decreases and vice versa. When utility power is lost, the UPS begins discharging the battery in order to support the attached load. Once power returns, the Smart-UPS will automatically begin to recharge its battery.

For a Matrix UPS:

> It is unnecessary to subject a battery bank to an excessively long calibration. Remove battery packs or increase the load (space heaters are good dummy loads) to obtain a reasonable time length for the calibration (under an hour if possible).
>
> At the start of a calibration, the Matrix microprocessor saves the Estimated Run Time displayed.

The unit will then go to battery power until the capacity is 25%. After this run time has been completed, the original Estimated Run Time is compared with the actual run time. It will then increase or decrease this value to correspond to the new run time achieved. If, at any time during the discharge, one of the following rules is violated the calibration will be aborted or corrupted:

1. Battery capacity must be 100% at start of calibration (all packs must indicated as float).
2. Initial "Estimated Run Time" must not exceed 128 minutes (remove battery packs if necessary).
3. Load must be above 25%.
4. Load must not fluctuate more than ± 5%.
5. The UPS must be allowed to run down to 25% battery capacity. PowerChute [or apcupsd] and Accessories must be removed since they can abort the calibration prematurely.

For a "dumb" or "simple signalling" UPS (eg a Back-UPS):

This could be done if you have changed your equipment load or battery. Stop the PowerChute [or apcupsd] software from running; disconnect the serial cable between the computer and UPS. Next unplug the UPS from the wall [suggest not disconnecting but simply turning off the utility power thereby preserving the earthing] and let it run on battery until it reaches low battery. Once it reaches low battery plug it back into the wall outlet [turn the utility power back on] and let it recharge. Recharge time can take up to 4 hours.

Resetting the UPS Battery Constant

In some cases none of the battery runtime calibration methods result in the UPS reporting a reasonably correct battery runtime. It has been speculated that this is because the battery constant value has drifted so far from normal that the microprocessor in the UPS cannot correct it.

The good news is that if you are located in the USA, all you have to do is contact APC Technical Support and they will send you a serial port *dongle* which plugs into the serial port of your UPS and reprograms the battery constant value for you to the correct value.

The bad news is that for many users outside the USA, this service does not appear to be available. It is, however, recommended that you first try contacting APC Technical Support to verify the correct battery constant value. The APC representatives in the Support Forum on the APC website are also very helpful in this regard.

If all else fails, the information below is for you.

WARNING: Only the values for the Smart-UPS 700 model SU700 and Smart-UPS 1400 model SU1400, both with international firmware (and therefore international voltage), have been verified. YOU, gentle reader, USE THIS INFORMATION AT YOUR OWN RISK in the full knowledge that you may render your UPS inoperable and perhaps irreparable, and you will have no-one to blame but yourself. *Caveat Utilitor!*

The battery constant is the hex number in the column labelled "0", presumably for register 0, in the following table:

```
UPS Model         4  5  6  0    Hex   Firmware
SU250               EE F8 B1
SU400               EE F8 9F    E1
SU600               EA F4 9F    E5
SU900               F3 FC 9F    ED
SU1250              EE FA 9F    F5
SU2000              F1 F9 9F    FD
SU450,700        28 F2 FA 96 07,RM=47  52.11.I
SU450XL,700XL    28 EE F8 9F 700XL=27   51.9.I
SU1000,INET      35 EF F9 A0    0B     60.11.I
SU1000XL         34 EE FC 9A    2B      61.9.I
SU1400           35 EE FC 9A            70.11.I
```

```
SU1400RM          28 ED FA 89
SU1400R2IBX135    08 B4 10 A3
SU1400RMXLI3U     45 F6 F4 80            73.x.I
SU1400RMXLI3U     20 F3 FD 81            73.x.I
SU2200I           35 EE FB AF           90.14.I
SU2200XL,3000     35 EE FB AF 3000=17   90.14.I
SU3000RMXLI3Ublk  35 F3 F4 AF    77     93.14.I
SU5000I white     20 F2 FA 91    1F    110.14.I
SU1400XL,XLI,RM   45 F6 E4 80
SU420I            25 95 09 85    16      21.7.I
SU420SI           0E 95 0A 8C
SU620I            29 99 0B 8A    1A
BP420SI           0E 95 0A 8C    06      11.2.I
BP650SI           10 97 0C 91    0A      12.3.I
Power Stack 250   0C 95 0F B2            26.5.I
Power Stack 450   0D 96 10 99    36      26.5.I
SC250RMI1U        0C 95 0F B3    32     735.a.1
SC420I            0E 95 OA 8C    16     725.1.I
SC620I            10 97 OB 99    1A     726.x.I
SC1000I           08 95 10 94    8A     737.x.I
SC1500I           07 95 14 8F    1E     738.x.I
SU1000XL          17 EE F9 D5
MATRIX 3000,5000     E9 F5 B0
SU700RMI2U        07 B1 0D 92    8A     152.4.I
SU1000RMI2U       08 B5 0D C7    8E     157.3.I
SU1400RMI2U       08 B4 10 A3    92     162.3.I
SUA1000I          07 B5 13 BC    0A    652.12.I
SUA1000XLI        0B BD 0F 7F    4A    681.13.I
SUA750XLI         0A B9 0C 86    46     630.3.I
SUA750I           04 B6 14 82    06    651.12.I
SUA750RMI2U       07 B1 0D 82    86    619.12.I
SUA1500I          09 B9 13 A1    0E 601/653.x.I
SUA1500RMI2U      08 B4 10 A1    8E     617.3.I
SUA2200I          08 B8 12 B3    26    654.12.I
SUA2200RMI2U      09 BC 11 81    A6     665.4.I
SUA2200XLI        0A B7 0F 7F    66     690.x.I
SUA3000RMI2U      04 B9 0E 70    AA     666.4.I
SUA3000RMXLI3U    0A B6 0E 89    xx     xxx.x.x
SUOL1000I         06 B6 1B A6
SUOL2000XL        0D BD 14 75    52     416.5.I
SURT1000XLI       0A BB 19 A8    4E     411.x.I
SURT3000XLI       06 B6 0F CC    56     450.2.I
SURT5000XLI       05 BA 15 86    5A    451.13.W
SURT7500XLI       03 BB 20 97    63
SURT10000XLI      06 B8 19 AB          476.12.W
SUM1500RMXLI2U    03 B7 0D A5    62     716.3.I
SUM3000RMXLI2U    03 B7 0D A5    6A     715.3.I
BP500AVR                         26      17.1.I
```

The instructions for resetting the battery constant are as follows:

1. Shutdown the apcupsd daemon;
2. Run apctest;
3. Choose option 6 to enter terminal mode;
4. Enter Y (UPS should respond SM);

5. Enter 1 (one, not el; wait 4 seconds);
6. Enter 1 (one, not el; UPS should respond PROG);
7. Enter 0 (zero, not oh; UPS should respond with current constant);
8. Write down the existing value so that if something goes wrong, you can at least put it back to that value;
9. Enter + (plus) or - (minus) to increment/decrement the value;
10. Enter R to reprogram constant value (UPS should respond Bye);
11. Enter Y (UPS should respond SM);
12. Enter 0 (zero, not oh; UPS should respond with the new constant);
13. Enter Esc to exit terminal mode;
14. Choose option 7 to exit apctest.

Frequently-Asked Questions

See the bugs section of this document for a list of known bugs and solutions.

Question: Why all the craziness with custom serial cables?

Answer: It was nothing more nor less than a form of customer control. For a long time APC wanted to keep other people from talking to its UPSes so it could lock out potential competition for its PowerChute software. Scrambling the leads on its serial cables was a cheap way to accomplish this -- in fact, they tended to be wired so that if you tried a straight-through cable, opening a serial link to the UPS would be interpreted as a shutdown command!

(Hardware companies often think like this -- they lock up interfaces by instinct, cornering a small market rather than growing a bigger one. It's fundamentally stupid and self-defeating, but it's the kind of stupid that tends to sound good at an executive meeting.)

Question: What UPS brands does apcupsd support?

Answer: Currently apcupsd supports only APC UPSes. However, some companies such as Hewlett Packard put their own brand name on APC manufactured UPSes. Thus even if you do not have an APC branded UPS, it may work with apcupsd. You will need to know the corresponding APC model number. apcupsd supports all the popular APC models. See the installation and configurations sections of this document for more details.

Question: Does apcupsd support Windows?

Answer: Yes.

Question: I don't have a cable, which one should I build?

Answer: First you must know if you have an apcsmart UPS or a voltage-signalling UPS. If you have a apcsmart UPS, we recommend building a Custom Smart cable. (see Smart-Custom Cable for SmartUPSes) If you have a voltage-signaling UPS, we recommend that you build a Custom Simple cable. (see Simple-Custom Voltage-Signalling Cable for "dumb" UPSes)

Question: How much CPU resources does apcupsd use?

Answer: Depending on your CPU speed, you may see more or less of the CPU consumed by apcupsd. On a 400MHz Unix system, the CPU usage should fall well below 0.1%. On slower systems, the percentage will increase proportionally to the decrease in the CPU speed. On a 400Mhz Win98 machine, the CPU usage will be on the order of 0.5-1.0%. This is higher than for Unix systems. However, compared to the 30% CPU usage by APC's PowerChute (the version on the CDROM shipped with my UPS), apcupsd's 0.5-1.0% is very modest.

Question: What language is apcupsd written in?

Answer: It is written in C and C++.

Question: To test apcupsd, I unplugged the UPS to simulate a power outage. After the machine went into the shutdown process I plugged the UPS back into the commercial power source. This caused the shutdown process to hang after the daemon tried to shut-off the ups. Have you run into this problem, and if so do you have a remedy?

Answer: Normally, once the shutdown process has begun, we cannot stop it -- how do you stop a shutdown that has killed off half of the daemons running on your system? Most likely you will be left with an unusable system. In addition, when apcupsd is re-executed in the halt script after the disks are synced, it tries to shut off the UPS power, but the UPS will generally refuse to do so if the AC power is on. Since we cannot be 100% sure whether or not the UPS will shut off the power, we don't attempt to reboot the system if we detect that the power is back as it might then get caught by a delayed power off (at least for Smart UPSes).

Question: After running apcupsd for a while, I get the following error: "Serial communications with UPS lost." What is the problem?

Answer: We use standard Unix serial port read() and write() calls so once a connection is made, we generally have few problems. However, there have been reports that APC's SNMP Management Card can cause serial port problems. If you have such a card, we suggest that you remove it and see if the problem goes away. It is also possible that some other process such as a getty is reading the serial port.

Question: I get the following error:

```
Starting apcupsd power management.
Mar 20 21:19:40 box apcupsd[297]: apcupsd FATAL ERROR in apcserial.c at line 83.
Cannot open UPS tty /dev/cua01: No such file or directory.
```

What is the problem?

Answer: The two most likely causes of your problem are: 1. You have the wrong serial port device name in the apcupsd.conf file. 2. The device name is not defined on your system. Suggestions for proceeding:For the first item, check what your serial port device should be named. You might be able to find the name with an:

```
ls /dev
```

Normally there will be hundreds or even thousands of names that print. If that doesn't produce anything useful, you can try step 2. Perhaps your device is not defined. To get more information on your devices try '`man MAKEDEV`' or '`find / -name MAKEDEV`'. It is often located in `/dev/MAKEDEV`. Looking at the documentation may tell you what the correct name is, or at least allow you to create the device.

Question: How do I ensure that the slaves shutdown before the master?

Answer: Slaves make their shutdown decision independently from the master. Therefore you can use the `TIMEOUT`, `MINUTES`, and `BATTERYLEVEL` settings in the slaves' apcupsd.conf to configure them to shut down before the master.

Question: How do I ensure that my database server is correctly shutdown?

Answer: You simply add whatever commands are necessary in the appropriate case statements in /etc/apcupsd/apccontrol, which is a standard script file that is called to actually do the shutdown. Alternatively, you can add your own script file that will be called before doing the commands in apccontrol. Your script file must have the same name as the appropriate case statement in apccontrol; it must be executable; and it must be in the same directory as apccontrol.

Customizing Event Handling

When apcupsd detects anomalies from your UPS device, it will make some decisions that usually result in one or more calls to the script located in `/etc/apcupsd/apccontrol`. The `apccontrol` file is a shell script that acts on the first argument that apcupsd passes to it. These actions are set up by default to sane behavior for all situations apcupsd is likely to detect from the UPS. However, you can change the apccontrol behavior for every single action.

To customize, so create a file with the same name as the action, which is passed as a command line argument. Put your script in the `/etc/apcupsd` directory.

These events are sent to the system log, optionally sent to the temporary events file (`/etc/apcupsd/apcupsd.events`), and they also generate a call to `/etc/apcupsd/apccontrol` which in turn will call any scripts you have placed in the `/etc/apcupsd` directory.

Normally, `/etc/apcupsd/apccontrol` is called only by apcupsd. Consequently, you should not invoke it directly. However, it is important to understand how it functions, and in some cases, you may want to change the messages that it prints using `wall`. We recommend that you do so by writing your own script to be invoked by `apccontrol` rather than by modifying apccontrol directly. This makes it easier for you to upgrade to the next version of apcupsd

In other case, you may want to write your own shell scripts that will be invoked by apccontrol. For example, when a power fail occurs, you may want to send an email message to root.

To write your own routine for the `powerout` action, you create shell script named `powerout` and put it in the lib directory (normally /etc/apcupsd). When the `powerout` action is invoked by apcupsd, apccontrol will first give control to your script. If you want apccontrol to continue with the default action, simply exit your script with an exit status of zero. If you do not want apccontrol to continue with the default action, your script should exit with the special exit code of 99. However, in this case, please be aware that you must ensure proper shutdown of your machine if necessary.

Some sample scripts (onbattery and mainsback) that email power failure messages can be found in /etc/apcupsd after an install or in the platforms/etc directory of the source code.

apccontrol Command Line Options

When apcupsd detects an event, it calls the apccontrol script with four arguments as:

`apccontrol` *event ups-name connected powered*

where:

event

is the event that occurred and it may be any one of the values described in the next section.

ups-name

is the name of the UPS as specified in the configuration file (not the name in the EEPROM).

connected

is 1 if apcupsd is connected to the UPS via a serial port (or a USB port). In most configurations, this will be the case. In the case of a Slave machine where apcupsd is not directly connected to the UPS, this value will be 0.

powered

is 1 if the computer on which apcupsd is running is powered by the UPS and 0 if not. At the moment, this value is unimplemented and always 0.

The following *event* names are supported:

annoyme

When a shutdown is scheduled, and the time specified on the ANNOYME directive in the apcupsd.conf file expires, this event is generated.
Default: `wall` a message

changeme

When apcupsd detects that the mains are on, but the battery is not functioning correctly, this event is generated. It is repeated every x hours.
Default: `wall` a message

commfailure

This event is generated each time the communications line with the computer is severed. This event is not detected on dumb signaling UPSes.
Default: `wall` a message

commok

After a commfailure event is issued, when the communications to the computer is re-established, this event will be generated.
Default: `wall` a message

doreboot

This event is depreciated and should not be used.
Default: Shuts down the system using `shutdown -h` or similar

doshutdown

When the UPS is running on batteries and one of the limits expires (time, run, load), this event is generated to cause the machine to shutdown.
Default: Shuts down the system using `shutdown -h` or similar

emergency

Called for an emergency system shutdown. (What triggers such a shutdown is unclear...) After completing this event, apcupsd will immediately initiate a `doshutdown` event.
Default: `wall` a message

failing

This event is generated when the UPS is running on batteries and the battery power is exhausted. The event following this one will be a shutdown.
Default: `wall` a message

loadlimit

This event is generated when the battery charge is below the low limit specified in the apcupsd.conf file. After completing this event, apcupsd will immediately initiate a `doshutdown` event.
Default: `wall` a message

powerout

This event is generated immediately when apcupsd detects that the UPS has switched to batteries. It may be due to a short powerfailure, an automatic selftest of the UPS, or a longer powerfailure.
Default: `wall` a message

onbattery

This event is generated 5 or 6 seconds after an initial powerfailure is detected. It means that apcupsd definitely considers the UPS to be on batteries. The onset of this event can be delayed by the `ONBATTERYDELAY` apcupsd.conf configuration directive.
Default: `wall` a message

offbattery

This event is generated when the mains return only if the onbattery event has been generated.
Default: `wall` a message

mainsback

This event is generated when the mains power returns after a powerout condition. The shutdown event may or may not have been generated depending on the parameters you have defined and the length of the power outage.
Default: nothing

remotedown

This event is generated on a slave machine when it detects either that the master has shutdown, or that a onbattery situation exists and the communications line has been severed.
Default: `wall` a message

runlimit

This event is generated when the `MINUTES` value defined in the apcupsd.conf file expires while in a power fail condition. The `MINUTES` is the remaining runtime as internally calculated by the UPS and monitored by apcupsd. After completing this event, apcupsd will immediately initiate a `doshutdown` event.
Default: `wall` a message

timeout

This event is generated when the `TIMEOUT` value defined in the apcupsd.conf file expires while in a power fail condition. It indicates that the total time in a power failure has been exceeded and the machine should be shutdown. After completing this event, apcupsd will immediately initiate a `doshutdown` event.
Default: `wall` a message

startselftest

This event is generated when apcupsd detects a self test by the UPS. Normally due to the 6 second onbattery delay default time, self test events are not detected.
Default: nothing

endselftest

This event is generated when the end of a self test is detected.
Default: nothing

battdetach

This event is generated when apcupsd detects that the UPS battery has been disconnected.
Default: nothing

battattach

This event is generated when apcupsd detects that the UPS battery has been reconnected after a battdetach event.
Default: nothing

Controlling Multiple UPSes on one Machine

The following discussion does not apply to Windows servers. Apcupsd on Windows is limited to a single instance and cannot support monitoring multiple UPSes.

If you have multiple UPSes in use, you may wish to consolidate the monitoring of all of these UPSes onto a single machine, which we shall call the "UPS server". Generally one of the UPSes is powering the "UPS server" itself (and possibly other machines as well). The remaining UPSes are powering additional machines.

Apcupsd can work quite well in this environment by running one instance of apcupsd on the UPS server for each UPS to be controlled. That is, you install a single copy of apcupsd but launch it multiple times using different configuration files and scripts. (Older versions of apcupsd required you to actually compile the daemon multiple times with different `configure` options. This is no longer required, as all necessary adjustments can be made in `apcupsd.conf`.)

Additionally, you will run one instance of apcupsd on each of the machines you wish to be shut down. You will configure each of these apcupsd's to use the 'net' driver to read UPS status from the proper instance of apcupsd on the UPS server. See NIS Server/Client Configuration Using the Net Driver for more information on the 'net' driver and setting up net clients.

Multiple UPS Example

There are many ways one could set up multiple apcupsd instances. Here I will present the way I have used with great success on Red Hat Linux.

I have two apcupsd.conf files (this is for a 2 UPS setup, easily expandable to N):

```
[adk0212@mail apcupsd]$ ls -l /etc/apcupsd/*.conf
-rw-r--r-- 1 root root 11799 Aug  3 08:39 /etc/apcupsd/apcupsd.ups0.conf
-rw-r--r-- 1 root root 11822 Aug 25 14:31 /etc/apcupsd/apcupsd.ups1.conf
```

In my case, ups0 is the UPS powering the UPS server running the multiple apcupsd instances, so only ups0 should initiate a shutdown of the local machine. The differences between the confs are minor since both UPSes are USB (although that is not a requirement; mixing cable types works fine too):

```
[adk0212@mail apcupsd]$ diff -u apcupsd.ups0.conf apcupsd.ups1.conf
--- apcupsd.ups0.conf   2007-08-03 08:39:26.000000000 -0400
+++ apcupsd.ups1.conf   2007-08-25 14:31:17.000000000 -0400
-UPSNAME ups0
+UPSNAME ups1
-DEVICE /dev/ups0
+DEVICE /dev/ups1
-SCRIPTDIR /etc/apcupsd
+SCRIPTDIR /etc/apcupsd/null
-PWRFAILDIR /etc/apcupsd
+PWRFAILDIR /etc/apcupsd/null
-NOLOGINDIR /etc
+NOLOGINDIR /etc/apcupsd/null
-ANNOY 300
+ANNOY 0
-NISPORT 3551
+NISPORT 3552
-EVENTSFILE /var/log/apcupsd.events
+EVENTSFILE /var/log/apcupsd.2.events
```

The important difference to note is that ups1 has its `SCRIPTDIR`, `PWRFAILDIR`, and `NOLOGINDIR` set to a special "null" directory that I have created. This directory contains a copy of the event handling scripts modified to avoid shutting down the local machine. (Details below). Also the UPSes are given different `EVENTSFILE` and `NISPORT` settings. Plus I disable the "annoy" feature on ups1. Since the state of that UPS does not impact local users, there's no reason to annoy them.

I have the following files in the special "null" directory:

```
[adk0212@mail apcupsd]$ ls -l /etc/apcupsd/null
total 32
-rwxr--r-- 1 root root 4176 Aug  3 08:24 apccontrol
-rwxr-xr-x 1 root root  475 Aug  3 08:28 changeme
-rwxr-xr-x 1 root root  502 Aug  3 08:28 commfailure
-rwxr-xr-x 1 root root  503 Aug  3 08:28 commok
-rwxr--r-- 1 root root    8 Aug  3 08:22 doshutdown
-rwxr-xr-x 1 root root  470 Aug  3 08:27 offbattery
-rwxr-xr-x 1 root root  435 Aug  3 08:27 onbattery
```

The important change here is the addition of a 'doshutdown' script which overrides apccontrol's shutdown action:

```
[adk0212@mail null]$ cat /etc/apcupsd/null/doshutdown
exit 99
```

The "exit 99" tells apccontrol to skip its normal processing for that event. apccontrol itself is unchanged; it is a direct copy of the original. The other scripts are also direct copies and have simply been modified to

generate status email from NISPORT 3552 instead of 3551.

I also have a custom init.d start/stop script to manage multiple instances. The start, stop, and status handlers are modified to iterate over all /etc/apcupsd/apcupsd.*.conf files. This is derived from the standard apcupsd redhat rc script:

```
#! /bin/sh
#
# apcupsd      This shell script takes care of starting and stopping
#              the apcupsd UPS monitoring daemon.
#
# chkconfig: 2345 60 99
# description: apcupsd monitors power and takes action if necessary
#

if test -f /etc/whitebox-release ; then
   f=/etc/whitebox-release
else
   f=/etc/redhat-release
fi
if test `cat $f | grep release |\
     cut -f 3 -d ' '`x = "Enterprise"x ; then
   DISTVER="Enterprise "`cat $f | grep release |\
     cut -f 6 -d ' '`
else
   DISTVER=`cat /etc/redhat-release | grep release |\
     cut -f 5 -d ' '`
fi

# Source function library
. /etc/rc.d/init.d/functions

case "$1" in
    start)
       rm -f /etc/apcupsd/powerfail
       rm -f /etc/nologin
       for conf in /etc/apcupsd/apcupsd.*.conf ; do
          inst=`basename $conf`
          echo -n "Starting UPS monitoring ($inst):"
          daemon /sbin/apcupsd -f $conf -P /var/run/apcupsd-$inst.pid
          RETVAL=$?
          echo
          [ $RETVAL -eq 0 ] && touch /var/lock/subsys/apcupsd-$inst
       done
       ;;
    stop)
       for conf in /etc/apcupsd/apcupsd.*.conf ; do
          inst=`basename $conf`
          echo -n "Shutting down UPS monitoring ($inst):"
          killproc -p /var/run/apcupsd-$inst.pid apcupsd
          echo
          rm -f /var/run/apcupsd-$inst.pid
          rm -f /var/lock/subsys/apcupsd-$inst
       done
       ;;
    restart|force-reload)
       $0 stop
```

```
       sleep 15
       $0 start
       ;;
    reload)
       echo "$0: reload not implemented"
       exit 3
       ;;
    status)
       for conf in /etc/apcupsd/apcupsd.*.conf ; do
          inst=`basename $conf`
          status -p /var/run/apcupsd-$inst.pid apcupsd-$inst
          RETVAL=$?
          if [ $RETVAL -eq 0 ]
          then
             NISPORT=`grep ^NISPORT < $conf | sed -e "s/NISPORT *\([0-9]\)/\1/"`
             /sbin/apcaccess status localhost:$NISPORT | egrep "(STATUS)|(UPSNAME)"
          fi
       done
       ;;
    *)
       echo "Usage: $0 {start|stop|restart|status}"
       exit 1
       ;;
esac
exit 0
```

That's about all there is to it. There are still some rough edges to clean up, but overall this is a *lot* easier with apcupsd 3.14.x than it used to be.

Support for SNMP UPSes

To run apcupsd with a SNMP UPS, you need the following things:

- An SNMP UPS, for example a Web/SNMP (AP9716) or PowerNet SNMP (AP9605) card installed into the SmartSlot. Apcupsd also has support for some non-APC SNMP UPSes using RFC1628 or MGE MIBs, however the majority of the information in this section is for APC UPSes.

Planning and Setup for SNMP Wiring

SNMP packet requests are relayed to the UPS from monitoring APCUPSD servers over Ethernet via a switch, hub, or router. Protecting these Ethernet devices with UPS supplied power is necessary to ensure reliable SNMP communication during power failures. Servers may fail to shutdown quietly during power failures if SNMP communication is lost.

Planning and Setup for SNMP Configuration

To establish communication to the UPS SNMP card installed in the UPS, the SNMP card will need the following:

- Assign SNMP card IP Address
- Set SNMP card General Parameters
- Set SNMP card Shutdown Parameters
- Set SNMP card Event Trap Receivers (apcupsd-3.12.0 and later)

Assign SNMP Card IP Address

The following instructions come from the APC knowledge base:

```
The Network Management Card (AP9617, AP9618, AP9619) must be
configured with network settings before it can communicate on the
network. Once the cards have been configured with an IP address,
Subnet Mask, and Default Gateway the cards can be access, managed,
and controlled from other computers on the network.

There are two ways to configure the Network Management Card (NMC)
with its initial settings: the (windows) Wizard and Address
Resolution Protocol (ARP).

1. The wizard in included on the CD that comes with the card. The
wizard must run on a Windows operating system. You can configure
the card using the wizard over the network via FTP. If using the
wizard please note, the un-configured NMC must be on the same
subnet as the computer running the wizard.

2. Address resolution protocol (arp) can also be used to configure
the NMC. The MAC Address of the NMC is needed for this method of
configuration. The MAC address is located on the quality assurance
slip that is shipped with the NMC, and is also located on the white
sticker on the NMC itself. From a computer on the same subnet as
the un-configured NMC, follow the instructions:

Open up a command prompt and type the following (replacing
<IPaddress> and <MacAddress> with the actual values):

arp -s <IPaddress> <MacAddress>

Next, use Ping with a size of 113 bytes to assign the IP address
defined by the ARP command.


-  Linux command format: ping <IPaddress> -s 113

-  Windows command format: ping <IPaddress> -l 113
```

Set SNMP card General Parameters

After the SNMP Network Management Card is configured with an IP address, the SNMP Card is ready for general configuration. This is accomplished by telneting to the SNMP Card.

```
~$ telnet <IPaddress>
```

Login using "apc" for both the username and password and the following menu will display:

```
*******************************************************************************
American Power Conversion              Network Management Card AOS      v2.6.4
(c) Copyright 2004 All Rights Reserved  Smart-UPS & Matrix-UPS APP       v2.6.1
-------------------------------------------------------------------------------
Name      :                                    Date : 07/03/2006
Contact   :                                 Time : 04:43:33
Location  :                                 User : Administrator
Up Time   : 0 Days 01 Hours 57 Minutes             Stat : P+ N+ A+

Smart-UPS 1000 named  : On Line, No Alarms Present
```

```
------- Control Console -------------------------------------------------------

     1- Device Manager
     2- Network
     3- System
     4- Logout

     <ESC>- Main Menu, <ENTER>- Refresh, <CTRL-L>- Event Log
>
*******************************************************************************
```

Select **Option 2** for Network. Next select **Option 1** for TCP/IP settings.

At this point the following settings will be to be specified:

- Verify System IP: <IPaddress>
- Specify Subnet Mask: i.e. "225.225.225.0"
- Specify Default Gateway
- Specify Host Name
- Specify Domain Name

Specifying these parameters will complete the General Parameters setup. Additionally the SNMP Network Management Card can now be connected to from a web browser for monitoring and additional configuration.

Set SNMP card Shutdown Parameters

There are two shutdown parameters that must be set in the SNMP card to ensure that connected servers shutdown quietly. These parameters can be set via the telnet terminal or the web browser interface.

- Shutdown Delay (sec)
- Return Battery Capacity (%)

One of the draw-backs of SNMP communication to the UPS is that the Stand-alone or Primary server must issue the power down command to the UPS early in server halt procedure. This server must issue an early command to the SNMP UPS to power down before its ethernet service is halted. This creates a potential problem where the UPS may kill power to any connected servers before these affected servers' halt scripts complete a successful shutdown.

The SNMP **Shutdown Delay** parameter is used to delay the UPS from killing power to its load by a prescribed period of seconds. The delay should be long enough to ensure that the Stand-alone or Primary server has enough time to successfully halt. The prescribed time should at least be 180 seconds. Any additional computers connected to the SNMP UPS must not be configured to issue the command to initiate UPS power down. These servers can be thought of as secondary stand-alone server. The APCUPSD daemons of secondary servers should be configured to initiate server halt a prescribed period of time before the Primary server issues the UPS power down command.

The **Return on Battery Capacity** is useful during intermittent sequential power failures. This parameter insures that the UPS will not restore power to its loads until it has recharged it battery to a prescribed percentage. This parameter should be set to a value greater than value that the APCUPSD daemons configured "BATTERYLEVEL" shutdown of any connected servers. This will ensure that when the UPS restores power, any additional power failures will successfully re-trigger a server shutdown.

Configure Event Trap Receivers

(Requires apcupsd-3.12.0 and later)

By default, APCUPSD will poll the SNMP UPS card once per minute. In this case, server notification of UPS alarms could potentially be delayed one minute. Event trap catching mitigates this shortcoming. Any UPS alarms are instantly sent to prescribe servers connected SNMP UPS. These servers are referred to as Event Trap Receivers. The SNMP UPS card can be configure to send event traps to a maximum of four receivers that will "catch" these events.

Event trap receivers IP address can be set using a telnet terminal or web browser interface.

Also, be aware that servers configured to be Event Trap Receivers should have static IP set. Severs obtaining IPs from DHCP server will not catch instantaneous Events if the IP address changes from the address set in the SNMP UPS.

Connecting APCUPSD to a SNMP UPS

The previous sections describe configuration of the actual SNMP card. The remaining sections describe configuration of the APCUPSD to communicate using SNMP Protocol.

To enable the SNMP support it is enough to configure the correct device in your apcupsd.conf configuration file. The directive needed for this configuration is:

```
DEVICE <host>:<port>:<vendor>:<community>
```

...where the directive is made by four parts. All but the first may be omitted completely or left empty to accept the default.

- *host*: IP address or DNS hostname of the UPS (required)
- *port*: Remote SNMP port (optional, default: 161)
- *vendor*: The type of SNMP MIB available on the UPS (optional, default: autodetect). Allowable choices for vendor are:
    - APC : APC PowerNet MIB, used on most APC brand UPSes
    - RFC : RFC1628 MIB, used by some non-APC UPSes
    - MGE : MGE MIB, used by many MGE brand UPSes
    - blank : Autodetect

  Append "_NOTRAP" to the vendor name to disable SNMP trap catching (ex: "APC_NOTRAP"). See SNMP Trap Catching.
- *community*: The read-write community string, usually "private". You can specify a read-only community string, usually "public", if you do not require killpower support. If the community string is omitted, apcupsd will attempt to autotedect by trying "private" and "public". (optional, default: autodetect).

A NIS Server/Client (Master/Slave) configuration with multiple servers is still applicable. However, an alternative configuration is possible with an SNMP enabled UPS. In this arrangement, all connected servers will be configured as a standalone server. Each will independently communicate to the UPS. One (primary) server will be chosen to manage the task of commanding the UPS to power down. All remaining (secondary) servers will be configured to quietly power down before the primary server issues the UPS power down command.

Building with SNMP support

Follow the instructions in Building and Installing apcupsd, being sure to include the following options (in addition to any others you need) on the '`./configure`' line:

```
./configure --enable-snmp
```

SNMP Trap Catching

apcupsd-3.11.14 introduces support for SNMP trap catching. Previous versions polled the UPS status once per minute, leading to significant delays before UPS state changes were recognized. With SNMP trap handling, apcupsd monitors the SNMP trap port and will re-poll the UPS whenever a trap is received. This happens, for example, when the UPS switches on or off battery.

In order for this feature to work, you must configure your UPS to deliver traps to the server running apcupsd. This is generally done by connecting to your SNMP card via a web browser or telnet connection. You will need to enter your server's IP address as a trap receiver and make sure trap delivery is enabled.

Trap catching can lead to problems if you are already running another SNMP trap daemon on your server. Only one daemon can listen to the trap port, so whichever one is started first will succeed and the others will fail. Apcupsd will fall back to polling behavior if it is unable to open the trap port. You can also forcibly disable trap catching by appending `_NOTRAP` to your vendor string in the apcupsd.conf `DEVICE` directive.

Known Problems

Currently (as of 3.10.0) the code to power off the UPS needs special configuration. The killpower command for SNMP UPSes can not be issued during shutdown as typically at some time during shutdown operations the network stack is stopped. To overcome this problem it is needed to modify the /etc/rc.d/apcupsd system control script to tell apcupsd to issue the power down command (killpower) to the UPS immediately before apcupsd initiates the system shutdown. For this reason it is paramount to set your UPS grace time to a value greater than 120 seconds to allow for clean shutdown operations before the UPS removes the power from its plugs. To enable correct shutdown operation during powerdown do the following:

- Connect to your Web/SNMP card using your favorite web browser, go to the UPS configuration menu and change the "Shutdown Delay" parameter to 180 seconds or more, depending on how much time your system shutdown requires to umount all the filesystems.
- **Option 1 (non-windows)** Edit the server halt script. Relocate the ups_kill_power() function higher in the shutdown sequence, primarily before the command to bring down the ethernet service. This is the preferred method for shutting down the UPS. The UPS will power down after the prescribed "Shut Down Delay" time (in seconds) has elapsed.
- **Option 2** Change /etc/rc.d/apcupsd script adding the `--kill-on-powerfail` to the apcupsd invocation. This method is not preferred because the UPS is commanded to power down without delay. This creates the potential for UPS powering down before the server calling for UPS power down completes its shutdown. However, in the case of Microsoft Windows OS, this is the only method available for powering down the UPS.
- Restart your apcupsd

With this setup your UPS operations should be safe.

apcupsd System Logging

The apcupsd philosophy is that all logging should be done through the `syslog` facility (see: '`man syslog`') This is now implemented with the exceptions that STATUS logging, for compatibility with prior versions is still done to a file, and EVENTS logging can be directed to a temporary file so that it can be reported by the network information server.

Logging Types

apcupsd splits its logging into four separate types called:

1. DEBUG
2. DATA
3. STATUS

4. EVENTS

Debug logging consists of debug messages. Normally these are turned on only by developers, and currently there exist very few of these debug messages.

Data Logging

This feature is somewhat outdated and not often used.

Data logging consists of periodically logging important data concerning the operation of the UPS. For the definitive definition of the format, see log_data() in apcreports.c. The format varies according to the UPS model and the information available from the UPS.

For UPS models, NBKPRO, SMART, SHARESMART, and MATRIX, the output is written in a format very similar to what PowerChute writes. That is:

MinLineVoltage, MaxLineVoltage, OutputVoltage, BatteryVoltage, LineFrequency, LoadPercent, UPSTemperature, AmbientTemperature, Humidity, LineVoltage, BatteryCharge, toggle

Any value that is not supported by your UPS such as AmbientTemperature and Humidity will be blank or possibly as 0.0. In any case the commas before and after that field will still be output. The toggle value alternates from 0 to 1 on each line. This was added at user request so that no two adjacent samples are identical.

An actual example from the log file is:

```
Nov  2 12:43:05 matou apcupsd[23439]: 224.9,227.5,226.2,27.74,50.00,100.0,30.6,,,226.2,50.0,1
```

Status Logging

Status logging consists of logging all available information known about your UPS as a series of ASCII records. This information is also made available by the apcupsd network information server.

For more details on STATUS logging, see the apcupsd Status Logging section for details.

EVENTS Logging

Events logging consists of logging events as they happen. For example, successful startup, power fail, battery failure, system shutdown, ...

See the Customizing Event Handling section for more details.

Implementation Details

In order to ensure that the data logged to syslog() can be directed to different files, I have assigned syslog() levels to each of our four types of data as follows:

1. DEBUG logging has level LOG_DEBUG
2. DATA logging has level LOG_INFO
3. STATUS logging has level LOG_NOTICE
4. EVENTS logging has levels LOG_WARNING, LOG_ERR, LOG_CRIT, and LOG_ALERT

It should be noted that more work needs to be done on the precise definitions of each of the levels for EVENTS logging. Currently, it is roughly broken down as follows:

LOG_WARNING general information such as startup, etc.

LOG_ERR an error condition detected, e.g. communications problem with the UPS.

LOG_CRIT a serious problem has occurred such as power failure, running on UPS batteries, ...

LOG_ALERT a condition that needs immediate attention such as pending system shutdown, ...

The default Facility for syslog() logging is DAEMON, although this can be changed with the FACILITY directive in apcupsd.conf. In the following example, we should the facility as local0.

More work needs to be done to the code to ensure that it corresponds to the above levels.

As a practical example of how to setup your syslog() to use the new logging feature, suppose you wish to direct all DATA logging to a file named /var/log/apcupsd.data, all EVENTS to the standard /var/log/messages file (to be mixed with other system messages), and at the same time send all EVENTS to /var/log/apcupsd.events, and finally, you want to send all STATUS logging to the named pipe /var/log/apcupsd.status

First as root, you create the named pipe:

```
mkfifo /var/log/apcupsd.status
```

Change its permissions as necessary or use the -m option to set them when creating the pipe.

Then you modify your /etc/syslog.conf file to direct the appropriate levels of messages where you want them. To accomplish the above, my syslog.conf file looks like:

```
# exclude all apcupsd info by default
*.info;local0.none                    /var/log/messages

# Everything for apcupsd goes here
local0.info;local0.!notice             /var/log/apcupsd.data
local0.notice;local0.!warn            |/var/log/apcupsd.status
local0.warn                            /var/log/apcupsd.events
local0.warn                            /var/log/messages
```

The Windows Version of apcupsd

The Windows version of apcupsd has been tested on Win95, Win98, WinMe, WinNT, WinXP, and Win2000 systems. This version of apcupsd has been built to run natively on Windows (no Cygwin or other emulation layer needed). Even though the Win32 version of apcupsd is a port that relies on many Unix features, it is just the same a true Windows program. When running, it is perfectly integrated with Windows and displays its icon in the system icon tray, and provides a system tray menu to obtain additional information on how apcupsd is running (status and events dialog boxes).

Once installed apcupsd normally runs as a system service. This means that it is immediately started by the operating system when the system is booted, and runs in the background even if there is no user logged into the system.

Installing Apcupsd on Windows

Normally, you will install the Windows version of apcupsd from the binaries. Starting with version 3.11.15, the Windows binaries are distributed with a full GUI installer driven by NSIS, the Nullsoft Scriptable Install System (http://nsis.sourceforge.net).

Installation is very simple and straight-forward: Simply double-click the installer executable and follow the instructions.

Configuring Apcupsd on Windows

If you are installing Apcupsd for the first time, the installer will give you an opportunity to edit the apcupsd.conf configuration file to contain the values appropriate for your site. (Subsequent installations will maintain your existing apcupsd.conf, so you need not edit it again unless there are new features or syntax changes that must be accounted for.)

The default configuration calls for a USB connected UPS. This is the most common connection for modern UPSes, especially those used with Windows computers. All other apcupsd drivers are available

(apcsmart, dumb, net, snmp, pcnet) and can be used simply by editing the configuration file `UPSCABLE`, `UPSTYPE`, and `DEVICE` settings as described elsewhere in this manual.

Note that on Windows, serial ports are specified using `COM1`, `COM2`, etc. notation instead of the UNIX-style /dev/tty* notation.

Note also if you are using WinNT or Win2000, the operating system may probe the serial port attempting to attach a serial mouse. This will cause apcupsd to be unable to communicate with the serial port. If this happens, or out of precaution, you can edit the `c:\\boot.ini` file. Find the line that looks something like the following:

```
multi(0)disk(0)rdisk(0)partition(1)\WINNT="Windows NT Workstation Version 4.00"
```

and add the following to the end of the line: `/NoSerialMice:COM1` (or COM2 depending on what you want to use). The new line should look similar to...

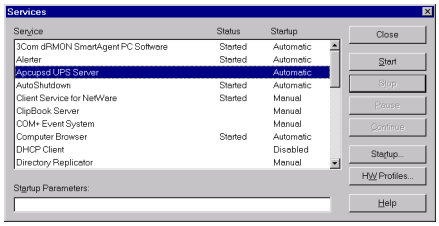
```
multi(0)disk(0)rdisk(0)partition(1)\WINNT="Windows NT Workstation Version 4.00" /NoSerialMice:COM1
```

...where the only thing you have changed is to append to the end of the line. This addition will prevent the operating system from interfering with apcupsd

Starting Apcupsd on Windows

The installer will give you an opportunity start the Apcupsd service immediately. If you choose to start it manually, you may do so by selecting the "Start Apcupsd" link from the Start->Programs->Apcupsd folder.

On Windows NT/2000/XP, you may alternatively go to the Control Panel, open the Services folder, select Apcupsd UPS Server, and then click on the **Start** button as shown below:



If the Services dialog reports a problem, it is normally because your `DEVICE` statement does not contain the correct serial port name.

You probably should also click on the **Startup...** button to ensure that the correct defaults are set. The dialogue box that appears should have **Startup Type** set to **Automatic* and **Logon** should be set to **System Account**. If these values are not set correctly by default, please change them otherwise apcupsd will not work.

For WinXP and Win2K systems, the dialogs are a bit different from those shown here for WinNT, but he concept is the same. You get to the Services dialog by clicking on: Control Panel -> Administrative Tools -> Component Services. The apcupsd service should appear in the right hand window when you click on **Services (Local)** in the left hand menu window.

That should complete the installation process. When the system tray icon turns from a question mark into a plug , right click on it and a menu will appear. Select the **Events** item, and the Events dialogue box should appear. There should be no error messages. By right clicking again on the system tray plug and selecting the **Status** item, you can verify that all the values for your UPS are correct.

When the UPS switches to the battery, the battery icon will appear in the system tray. While the UPS is online, if the battery is not at least 99% charged, the plug icon will become a plug with a lightning bolt in the middle to indicate that the battery is charging.

Apctray

Starting with version 3.14.2, the tray icon is provided by a separate program called 'apctray'. This cleanly separates the user interface from the daemon (service) and is required for tray icon support on Windows Vista. Note that if you close or disable the tray icon this does **not** stop or disable the apcupsd service which will continue to monitor the UPS and shutdown the computer when appropriate. To stop or disable the service, use the service control panel.

apctray has the capability of monitoring multiple apcupsd instances using apcupsd's Network Information Server (NIS). It will create a new icon for each instance being monitored. By default, apctray monitors the local apcupsd (localhost on port 3551). To add additional monitors, you can right-click an existing icon and choose "Add Monitor". To remove a monitor, right-click its icon and choose "Remove Monitor". To change thr settings for an existing monitor (ip address, port, refresh rate), right-click its icon and choose "Configure...".

apctray can be installed standalone (without apcupsd) if you wish to use it only to monitor remote apcupsd instances. This can be convenient for keeping an eye on a room full of UPSes from your desktop. Download and run the normal apcupsd installer and simply uncheck all components except apctray. Then add as many monitors as you wish as described above.

Testing Apcupsd on Windows

It would be hard to overemphasize the need to do a full testing of your installation of apcupsd as there are a number of reasons why it may not behave properly in a real power failure situation.

Please read the Testing Apcupsd section of this document for general instructions on testing the Win32 version. However, on Win32 systems, there is no Unix system log file, so if something goes wrong, look in the file `c:\apcupsd\etc\apcupsd\apcupsd.events` where apcupsd normally logs its events, and you will generally find more detailed information on why the program is not working. The most common cause of problems is either improper configuration of the cable type, or an incorrect address for the serial port. Additionally, check the application event log, if you're running a platform that supports it such as Windows 2000 or XP.

Upgrading

An upgrade may be accomplished by uninstalling the old version (using the Add/Remove Programs Control Panel or clicking the "Uninstall Apcupsd" link from Start -> Programs -> Apcupsd. Near the end of the uninstall you will be prompted about removing configuration and event files. You should answer "No" in order to preserve your existing apcupsd.conf file.

After the uninstall completes you may install the new version of Apcupsd as described above. If you preserved your existing apcupsd.conf file, the new apcupsd.conf will be installed as apcupsd.conf.new.

Post-Installation

After installing apcupsd and before running it, you should check the contents of the config file `c:\apcupsd\etc\apcupsd\apcupsd.conf`. You will probably need to change your UPSCABLE directive, your UPSTYPE and possibly your DEVICE directives. Please refer to the configuration section of this manual for more details.

Problem Areas

On some Windows systems, the domain resolution does not seem to work if you have not configured a DNS server in the Network section of the Control Panel. This problem should be apparent only when running a slave configuration. In this case, when you specify the name of the master in your apcupsd.conf file, apcupsd will be unable to resolve the name to a valid IP address. To circumvent this problem, simply enter the address as an IP address rather than a hostname, or alternatively, ensure that you have a valid DNS server configured on your system.

On WinNT, WinXP, and Win2K systems, you can examine the System Applications log to which apcupsd writes Windows error messages during startup.

Regardless of which Windows system you are running, apcupsd logs most error messages to `c:\apcupsd\etc\apcupsd\apcupsd.events`. This type error messages such as configuration file not found, etc are written to this file. Note that on some systems (WinXP, possibly others) Apcupsd is unable to write to this file when running as a service.

Email Notification of Events

It is possible to receive email notification of apcupsd events using some simple Visual Basic scripts contributed by Ed Dondlinger <edondlinger@thepylegroup.com>. The scripts are automatically installed in the `etc/apcupsd` directory of your apcupsd installation but are disabled by default. To enable them, first open them in a text editor such as Notepad and edit the `USER VARIABLES` section to set your email preferences including address, server information, etc. Then rename the script files without the `*.example` suffix. Scripts are supplied for onbattery, offbattery, and commfailure events. You can copy the scripts to other filenames and modify the email body text to respond to other events as described in Customizing Event Handling.

Killpower under Windows

If your batteries become exhausted during a power failure and you want your machine to automatically reboot when the power comes back, it is useful to implement the killpower feature of the UPS where apcupsd sends the UPS the command to shut off the power. In doing so, the power will be cut to your PC and if your BIOS is properly setup, the machine will automatically reboot when the power comes back. This is important for servers.

This feature is implemented on Unix systems by first requesting a system shutdown. As a part of the shutdown, apcupsd is terminated by the system, but the shutdown process executes a script where apcupsd is recalled after the disks are synced and the machine is idle. Apcupsd then requests the UPS to shut off the power (killpower).

Unfortunately on Windows, there is no such shutdown script that we are aware of and no way for apcupsd to get control after the machine is idled. If this feature is important to you, it is possible to do it by telling apcupsd to immediately issue the killpower command after issuing the shutdown request. The danger in doing so is that if the machine is not sufficiently idled when the killpower takes place, the disks will need to be rescanned (and there is a possibility of lost data however small). Generally, UPSes have a shutdown grace period which gives sufficient time for the OS to shutdown before the power is cut.

To implement this feature, you need to add the `-p` option to the apcupsd command line that is executed by the system. Currently the procedure is manual. You do so by editing the registry and changing the line:

```
c:\apcupsd\apcupsd.exe /service
```

found under the key:

```
HKEY_LOCAL_MACHINE Software\Microsoft\Windows\CurrentVersion\RunServices
```

to

```
c:\apcupsd\apcupsd.exe /service -p
```

If you have a Smart UPS, you can configure the kill power grace period, and you might want to set it to 3 minutes. If you have a dumb UPS, there is no grace period and you should not use this procedure. If you have a Back-UPS CS or ES, these UPSes generally have a fixed grace period of 2 minutes, which is probably sufficient.

Power Down During Shutdown

Our philosophy is to shutdown a computer but not to power it down itself (as opposed to having the UPS cut the power as described above). That is we prefer to idle a computer but leave it running. This has the

advantage that in a power fail situation, if the killpower function described above does not work, the computer will continue to draw down the batteries and the UPS will hopefully shutoff before the power is restore thus permitting an automatic reboot.

Nevertheless some people prefer to do a full power down. To do so, you might want to get a copy of PsShutdown, which does have a power down option. You can find it and a lot more useful software at: http://technet.microsoft.com/en-us/sysinternals/bb897541.aspx. To use their shutdown program rather than the apcupsd supplied version, you simply edit:

```
c:\apcupsd\etc\apcupsd\apccontrol
```

with any text editor and change our calls to shutdown to psshutdown.

Command Line Options Specific to the Windows Version

These options are not normally seen or used by the user, and are documented here only for information purposes. At the current time, to change the default options, you must either manually run apcupsd or you must manually edit the system registry and modify the appropriate entries.

In order to avoid option clashes between the options necessary for apcupsd to run on Windows and the standard apcupsd options, all Windows specific options are signaled with a forward slash character (`/`), while as usual, the standard apcupsd options are signaled with a minus (`-`), or a minus minus (`--`). All the standard apcupsd options can be used on the Windows version. In addition, the following Windows only options are implemented:

`/service`	Start apcupsd as a service
`/run`	Run the apcupsd application
`/install`	Install apcupsd as a service in the system registry
`/remove`	Uninstall apcupsd from the system registry
`/about`	Show the apcupsd about dialogue box
`/kill`	Stop any running apcupsd
`/help`	Show the apcupsd help dialogue box

It is important to note that under normal circumstances the user should never need to use these options as they are normally handled by the system automatically once apcupsd is installed. However, you may note these options in some of the .pif files that have been created for your use.

Installation: Serial-Line UPSes

Overview of Serial-Interface UPSes

If you have a UPS that communicates via serial port, you need to do two things before you can even think about configuring the software. First, you need to figure out whether it's a dumb (voltage-signalling) UPS or speaks the apcsmart protocol. Second, if you have an interface cable from APC, you need to figure out what kind it is. If you don't have such a cable, you need to build one. A straight-through serial cable won't work.

According to Bill Marr the Belkin F5U109, also sold as F5U409 also works with apcupsd for kernel versions 2.4.25 or higher and kernels 2.6.1 and higher. These newer kernels are needed to have the patch that makes the mct_u232 (Magic Control Technology) module and other adapters work with RS-232 devices that do not assert the CTS signal.

Connecting a Serial-Line UPS to a USB Port

By using a special adaptor, you can connect your serial-line UPS to a USB port. If you would like to free up your serial port and connect your existing serial port UPS to a USB port, it is possible if you have one of the later kernels. You simply get a serial to USB adapter that is supported by the kernel, plug it in and make one minor change to your apcupsd.conf file and away you go. (Kern adds: Thanks to Joe Acosta for

pointing this out to me.)

The device that Joe Acosta and Kern are using is IOgear GUC232A USB 2 serial adapter. Bill Marr informs us that it also works with a Back-UPS Pro 650 and the 940-0095B cable.

At Kern's site, running Red Hat 7.1 with kernel 2.4.9-12, he simply changed his /etc/apcupsd/apcupsd.conf configuration line to be:

```
DEVICE /dev/ttyUSB0
```

Depending on whether or not you have hotplug working, you may need to explicitly load the kernel modules `usbserial` and `pl2303`. In Kern's case, this was not necessary.

Testing Serial-Line UPSes

If you have a serial-line UPS, there are some tests you should run before the general ones described in the Testing Apcupsd section.

To test your computer's connection with a serial-line UPS, you first need to establish that the serial line is functioning, and then that the UPS is responding to commands. This can be a bit tricky, especially with a dumb voltage-signalling interface, because it is completely quiescent when there are no commands being passed, and the command repertoire doesn't include any self-tests.

Because it is easy to configure a serial cable incorrectly in such a way as to cause premature shutdowns of the UPS power, we *strongly* recommend, especially for voltage- signaling (dumb) UPSes, that you do most of the initial testing with your computer plugged into the wall rather than your UPS. Thus if the UPS power is suddenly shut off, your computer will continue to run. We also recommend using safe-apccontrol as described below, until you are sure that the signaling is correct.

Also note that if you launch the execution of apcupsd while your voltage-signaling UPS is on battery power, it is very likely that your UPS will immediately shut off the power. This is due to the initialization of the serial port line signals, which often looks to the UPS like a shutdown command.

Finally, double-check the state of your cabling and UPS indicator lights frequently during testing. For voltage-signaling UPSes, apcupsd is not currently able to detect whether or not the serial cable is connected. In addition, some simple signaling UPSes with certain cable combinations are not able to detect the low battery condition. For more details please see Voltage Signalling Features Supported by Apcupsd for Various Cables.

Establishing Serial Port Connection

Once you have compiled, installed, and invoked apcupsd, you should wait to allow apcupsd to configure itself and establish contact with the UPS.

If you see a message similar to the following about 30 seconds after starting apcupsd...

```
apcupsd FATAL ERROR in apcserial.c at line 156
PANIC! Cannot communicate with UPS via serial port.
```

it means that apcupsd tried for about 30 seconds to establish contact with the UPS via the serial port, but was unable to do so. Before continuing, you must correct this problem. Some of the possible sources of the problem are:

- You have not configured the correct serial port name on the `DEVICE` directive in your apcupsd configuration file.
- The serial port that you have chosen has logins enabled. You must disable logins on that port, otherwise, the system prevents apcupsd from using it. Normally, the file /etc/inittab specifies the ports for which a getty process is started (on Sun machines, the serial port program equivalent to getty is called ttymon). You must disable this for the port that you wish to use.

- Make sure you are doing your testing as root otherwise, you may have permissions problems accessing the serial port.
- You may have cabling problems, either with an incorrect cable, or the incorrect cable specification directive in the configuration file.
- You may have a problem with the /etc/apcupsd/acpupsd.conf file. For example, check that you have specified the correct type of UPS and the correct networking directives. For more details, see the After Installation section.
- If you have a SmartUPS 5000 RM 15U or similar model, that comes with a "Web/SNMP management card" in one of the "Smart Slots", this card may interfere with the serial port operation. If you are having problems, please remove this card and try again. Supposedly V3.0 of the card firmware has been corrected to properly release the serial port.
- Ensure that you have no other programs that are using the serial port. One user reported that he had problems because the serial port mouse (gpm) was using the same port as apcupsd. This causes intermittent seemingly random problems.
- Try connecting your UPS to another machine. If it works, then you probably have a bad serial port card. As unlikely as this may sound, at least two of our users have had to replace bad serial port cards.
- Try doing an '`lsof /dev/ttyS0`' where you replace the `/dev/ttyS0` with your serial port name. If you get no output, the port is free (or there is no physical port). If you get output, then another program is using the port, and you should see which one.
- Try doing a '`dmesg | grep tty`'. This may show you if a program has grabbed the port. (Thanks to Joe Acosta for the suggestion.)
- If all else fails, make sure your system is configured for serial port support.

The first thing to do is to look at your log file, usually /var/log/messages because apcupsd writes more detailed information to the log file whenever there is an error.

If you have a UPS that uses apcsmart protocol, you can manually test the serial communications with the UPS by starting a serial port communications program (such as minicom, tip, or cu) with the settings 2400 8N1 (2400 baud, 8 data bits, no parity, 1 stop bit). Be extremely careful what you send to your UPS as certain characters may cause it to power down or may even cause damage to the UPS. Try sending an upper case `Y` to the UPS (without a return at the end). It should respond with `SM`. If this is not the case, review the possible problems listed above. If you fat finger the Y and enter y instead, no cause for alarm, you will simply get the APC copyright notice.

Once you are sure that serial port communications is working, proceed to the next test.

Once you have established serial communications

Once you have established that apcupsd can talk to the UPS over the serial part, go do the series of functional tests described in the main Testing section (see Testing Apcupsd).

Troubleshooting Serial Line communications

The most frequently encountered problem with voltage-signalling UPSes (e.g. BackUPS 650) is that you have incorrectly specified which cable is being used. All cables furnished by APC have the cable number stamped on the side of the computer connector end of the cable. Using this number with apcupsd will normally work fine. If you do not know what cable you have, you can use the apctest program to determine the type of the cable.

For simple signaling UPSes, you should **not** use `simple` in the cable specification (i.e. `UPSCABLE simple`) unless you have made the cable yourself according to the wiring diagram given in the cables chapter of this manual.

Bizarre Intermittent Behavior:

In one case, a user reported that he received random incorrect values from the UPS in the status output. It turned out that gpm, the mouse control program for command windows, was using the serial port without using the standard Unix locking mechanism. As a consequence, both apcupsd and gpm were reading the serial port. Please ensure that if you are running gpm that it is not configured with a serial port mouse on the same serial port.

Cables

You can either use the cable that came with your UPS (the easiest if we support it) or you can make your own cable. We recommend that you obtain a supported cable directly from APC.

If you already have an APC cable, you can determine what kind it is by examining the flat sides of the two connectors where you will find the cable number embossed into the plastic. It is generally on one side of the male connector.

To make your own cable you must first know whether you have a UPS that speaks the apcsmart protocol or a "dumb" UPS that uses serial port line voltage signalling.

If you have an smart UPS, and you build your own cable, build a Smart-Custom cable (see Smart-Custom Cable for SmartUPSes). If you have a voltage-signalling or dumb UPS, build a Simple-Custom cable (see Simple-Custom Voltage-Signalling Cable for "dumb" UPSes). If you have a BackUPS CS with a RJ45 connector, you can build your own Custom-RJ45 cable (see Custom-RJ45 Smart Signalling Cable for BackUPS CS Models).

Smart-Custom Cable for SmartUPSes

You do not have this cable unless you built it yourself. The Smart-Custom cable is not an APC product.

```
  SMART-CUSTOM CABLE

Signal Computer                  UPS
       DB9F                     DB9M
 RxD    2   --------------------  2  TxD  Send
 TxD    3   --------------------  1  RxD  Receive
 GND    5   --------------------  9  Ground
```

When using this cable with apcupsd specify the following in apcupsd.conf:

```
UPSCABLE smart
UPSTYPE apcsmart
DEVICE /dev/ttyS0 (or whatever your serial port is)
```

If you have an OS that requires DCD or RTS to be set before you can receive input, you might try building the standard APC Smart 940-0024C cable listed below (see 940-0024C Cable Wiring).

Simple-Custom Voltage-Signalling Cable for "dumb" UPSes

You do not have this cable unless you built it yourself. The Simple-Custom cable is not an APC product.

For "dumb" UPSes using voltage signalling, if you are going to build your own cable, we recommend to make the cable designed by the apcupsd team as follows:

```
       SIMPLE-CUSTOM CABLE

Signal Computer                  UPS
       DB9F   4.7K ohm          DB9M
 DTR    4   --[####]--*             DTR set to +5V by Apcupsd
                      |
```

```
CTS    8   ----------*---------  5  Low Battery
GND    5   --------------------  4  Ground
DCD    1   --------------------  2  On Battery
RTS    7   --------------------  1  Kill UPS Power
```

List of components one needs to make the Simple cable:

1. One (1) male DB9 connector, use solder type connector only.
2. One (1) female DB9/25F connector, use solder type connector only.
3. One (1) 4.7K ohm 1/4 watt 5% resistor.
4. rosin core solder.
5. three (3) to five (5) feet of 22AWG multi-stranded four or more conductor cable.

Assembly instructions:

1. Solder the resistor into pin 4 of the female DB9 connector.
2. Next bend the resistor so that it connects to pin 8 of the female DB9 connector.
3. Pin 8 on the female connector is also wired to pin 5 on the male DB9 connector. Solder both ends.
4. Solder the other pins, pin 5 on the female DB9 to pin 4 on the male connector; pin 1 on the female connector to pin 2 on the male connector; and pin 7 on the female connector to pin 1 on the male connector.
5. Double check your work.

We use the DTR (pin 4 on the female connector) as our +5 volts power for the circuit. It is used as the Vcc pull-up voltage for testing the outputs on any "UPS by APC" in voltage-signalling mode. This cable may not work on a BackUPS Pro if the default communications are in apcsmart mode. This cable is also valid for use on a ShareUPS BASIC Port. It is reported to work on SmartUPSes, however the Smart Cable described above is preferred.

To have a better idea of what is going on inside apcupsd, for the SIMPLE cable apcupsd reads three signals and sets three:

Reads:

CD, which apcupsd uses for the On Battery signal when high.
CTS, which apcupsd uses for the Battery Low signal when high.

RxD (SR), which apcupsd uses for the Line Down

signal when high. This signal isn't used for much.

Sets:

DTR, which apcupsd sets when it detects a power failure (generally

5 to 10 seconds after the CD signal goes high). It clears this signal if the CD signal subsequently goes low -- i.e. power is restored.

TxD (ST), which apcupsd clears when it detects that the CD signal

has gone low after having gone high - i.e. power is restored.

RTS, which apcupsd sets for the killpower signal -- to cause the UPS

to shut off the power.

Please note that these actions apply only to the SIMPLE cable. The signals used on the other cables are different.

Finally, here is another way of looking at the CUSTOM-SIMPLE cable:

```
APCUPSD SIMPLE-CUSTOM CABLE

Computer Side  |  Description of Cable           |     UPS Side
DB9f  |  DB25f |                                  |   DB9m  | DB25m
4     |   20   |  DTR (5vcc)             *below   |    n/c  |
8     |    5   |  CTS (low battery)      *below   | <-  5   |   7
2     |    3   |  RxD (no line voltage)  *below   | <-  3   |   2
5     |    7   |  Ground (Signal)                 |     4   |  20
1     |    8   |  CD (on battery from UPS)        | <-  2   |   3
7     |    4   |  RTS (kill UPS power)            | ->  1   |   8
n/c   |    1   |  Frame/Case Gnd (optional)       |     9   |  22

Note: the <- and -> indicate the signal direction.
```

When using this cable with apcupsd specify the following in apcupsd.conf:

```
UPSCABLE simple
UPSTYPE dumb
DEVICE /dev/ttyS0 (or whatever your serial port is)
```

Custom-RJ45 Smart Signalling Cable for BackUPS CS Models

If you have a BackUPS CS, you are probably either using it with the USB cable that is supplied or with the 940-0128A supplied by APC, which permits running the UPS in dumb mode. By building your own cable, you can now run the BackUPS CS models (and perhaps also the ES models) using smart signalling and have all the same information that is available as running it in USB mode.

The jack in the UPS is actually a 10 pin RJ45. However, you can just as easily use a 8 pin RJ45 connector, which is more standard (ethernet TX, and ISDN connector). It is easy to construct the cable by cutting off one end of a standard RJ45-8 ethernet cable and wiring the other end (three wires) into a standard DB9F female serial port connector.

Below, you will find a diagram for the CUSTOM-RJ45 cable:

```
  CUSTOM-RJ45 CABLE

Signal Computer              UPS     UPS
       DB9F                RJ45-8  RJ45-10
 RxD    2   ----------------  1      2     TxD  Send
 TxD    3   ----------------  7      8     RxD  Receive
 GND    5   ----------------  6      7     Ground
 FG  Shield ----------------  3      4     Frame Ground

The RJ45-8 pins are: looking at the end of the connector:

 8 7 6 5 4 3 2 1
_________________
| . . . . . . . . |
|                 |
-------------------
       |____|

The RJ45-10  pins are: looking at the end of the connector:

10 9 8 7 6 5 4 3 2 1
____________________
```

```
| . . . . . . . . . . |
|                     |
-----------------------
       |____|
```

For the serial port DB9F connector, the pin numbers are stamped in the plastic near each pin. In addition, there is a diagram near the end of this chapter.

Note, one user, Martin, has found that if the shield is not connected to the Frame Ground in the above diagram (not in our original schematic), the UPS (a BackUPS CS 500 EI) will be unstable and likely to rapidly switch from power to batteries (i.e. chatter).

When using this cable with apcupsd specify the following in apcupsd.conf:

```
UPSCABLE smart
UPSTYPE apcsmart
DEVICE /dev/ttyS0 (or whatever your serial port is)
```

The information for constructing this cable was discovered and transmitted to us by slither_man. Many thanks!

Other APC Cables that apcupsd Supports

apcupsd will also support the following off the shelf cables that are supplied by APC

- 940-0020[B/C] Simple Signal Only, all models.
- 940-0023A Simple Signal Only, all models.
- 940-0119A Simple Signal Only, Back-UPS Office, and BackUPS ES.
- 940-0024[B/C/G] Smart mode Only, SU and BKPro only.
- 940-0095[A/B/C] PnP (Plug and Play), all models.
- 940-1524C Smart mode Only
- 940-0128A Simple Signal Only, Back-UPS CS in serial mode.
- All USB cables such as 940-0127[A/B]

Voltage Signalling Features Supported by Apcupsd for Various Cables

The following table shows the features supported by the current version of apcupsd for various cables running the UPS in voltage-signalling mode.

Cable	Power Loss	Low Battery	Kill Power	Cable Disconnected
940-0020B	Yes	No	Yes	No
940-0020C	Yes	Yes	Yes	No
940-0023A	Yes	No	No	No
940-0119A	Yes	Yes	Yes	No
940-0127A	Yes	Yes	Yes	No
940-0128A	Yes	Yes	Yes	No
940-0095A/B/C	Yes	Yes	Yes	No
simple	Yes	Yes	Yes	No

Voltage Signalling

Apparently, all APC voltage-signalling UPSes with DB9 serial ports have the same signals on the output pins of the UPS. The difference at the computer end is due to different cable configurations. Thus, by measuring the connectivity of a cable, one can determine how to program the UPS.

The signals presented or accepted by the UPS on its DB9 connector using the numbering scheme listed above is:

```
UPS Pin         Signal meaning
 1     <-     Shutdown when set by computer for 1-5 seconds.
 2     ->     On battery power (this signal is normally low but
                   goes high when the UPS switches to batteries).
 3     ->     Mains down (line fail) See Note 1 below.
 5     ->     Low battery. See Note 1 below.
 6     ->     Inverse of mains down signal. See Note 2 below.
 7     <-     Turn on/off power (only on advanced UPSes only)

 Note 1: these two lines are normally open, but close when the
     appropriate signal is triggered. In fact, they are open collector
     outputs which are rated for a maximum of +40VDC and 25 mA. Thus
     the 4.7K ohm resistor used in the Custom Simple cable works
     quite well.

 Note 2: the same as note 1 except that the line is normally closed,
     and opens when the line voltage fails.
```

The Back-UPS Office 500 signals

The Back-UPS Office UPS has a telephone type jack as output, which looks like the following:

```
Looking at the end of the connector:

   6 5 4 3 2 1
  _____________
 | . . . . . . |
 |             |
 |  |----------|
 |__|
```

It appears that the signals work as follows:

```
  UPS            Signal meaning
1 (brown)    <-   Shutdown when set by computer for 1-5 seconds.
2 (black)    ->   On battery power
3 (blue)     ->   Low battery
4 (red)           Signal ground
5 (yellow)   <-   Begin signalling on other pins
6 (none)          none
```

Analyses of APC Cables

940-0020B Cable Wiring

Supported Models: Simple Signaling such as BackUPS

Contributed by: Lazar M. Fleysher

Although we do not know what the black box semiconductor contains, we believe that we understand its operation (many thanks to Lazar M. Fleysher for working this out).

This cable can only be used on voltage-signalling UPSes, and provides the On Battery signal as well as kill UPS power. Most recent evidence (Lazar's analysis) indicates that this cable under the right conditions may provide the Low Battery signal. This is yet to be confirmed.

This diagram is for informational purposes and may not be complete. We don't recommend that use it to build you build one yourself.

```
APC Part# - 940-0020B

Signal Computer                  UPS
       DB9F                     DB9M
 CTS    8   --------------------  2  On Battery
 DTR    4   --------------------  1  Kill power
 GND    5   ---------------*----  4  Ground
                           |
                 ---       *----  9  Common
 DCD    1  ----|///|-----------   5  Low Battery
               |\\\|
 RTS    7  ----|///| (probably a
                ---   semi-conductor)
```

940-0020C Cable Wiring

Supported Models: Simple Signaling such as BackUPS

This cable can only be used on voltage-signalling UPSes, and provides the On Battery signal, the Low Battery signal as well as kill UPS power. You may specify `UPSCABLE 940-0020C`.

This diagram is for informational purposes and may not be complete. We don't recommend that use it to build you build one yourself.

```
APC Part# - 940-0020C

Signal Computer                  UPS
       DB9F                     DB9M
 CTS    8   --------------------  2  On Battery
 DTR    4   --------------------  1  Kill power
 GND    5   ---------------*----  4  Ground
                           |
                           *----  9  Common
 RTS    7 -----[ 93.5K ohm ]-----  5  Low Battery
              or semi-conductor
```

940-0023A Cable Wiring

Supported Models: Simple Signaling such as BackUPS

This cable can only be used on voltage-signalling UPSes, and apparently only provides the On Battery signal. As a consequence, this cable is pretty much useless, and we recommend that you find a better cable because all APC UPSes support more than just On Battery. Please note that we are not sure the

following diagram is correct.

This diagram is for informational purposes and may not be complete. We don't recommend that use it to build you build one yourself.

```
APC Part# - 940-0023A

Signal Computer                  UPS
       DB9F                     DB9M
 DCD    1   --------------------  2  On Battery

              3.3K ohm
 TxD    3   --[####]-*
                     |
 DTR    4   ---------*
 GND    5   ---------------*----  4  Ground
                           |
                           *----  9  Common
```

940-0024C Cable Wiring

Supported Models: SmartUPS (all models with DB9 serial port)

If you wish to build the standard cable furnished by APC (940-0024C), use the following diagram.

```
APC Part# - 940-0024C

Signal Computer                  UPS
       DB9F                     DB9M
 RxD    2   --------------------  2  TxD  Send
 TxD    3   --------------------  1  RxD  Receive
 DCD    1   --*
              |
 DTR    4   --*
 GND    5   --------------------  9  Ground
 RTS    7   --*
              |
 CTS    8   --*
```

940-0095A Cable Wiring

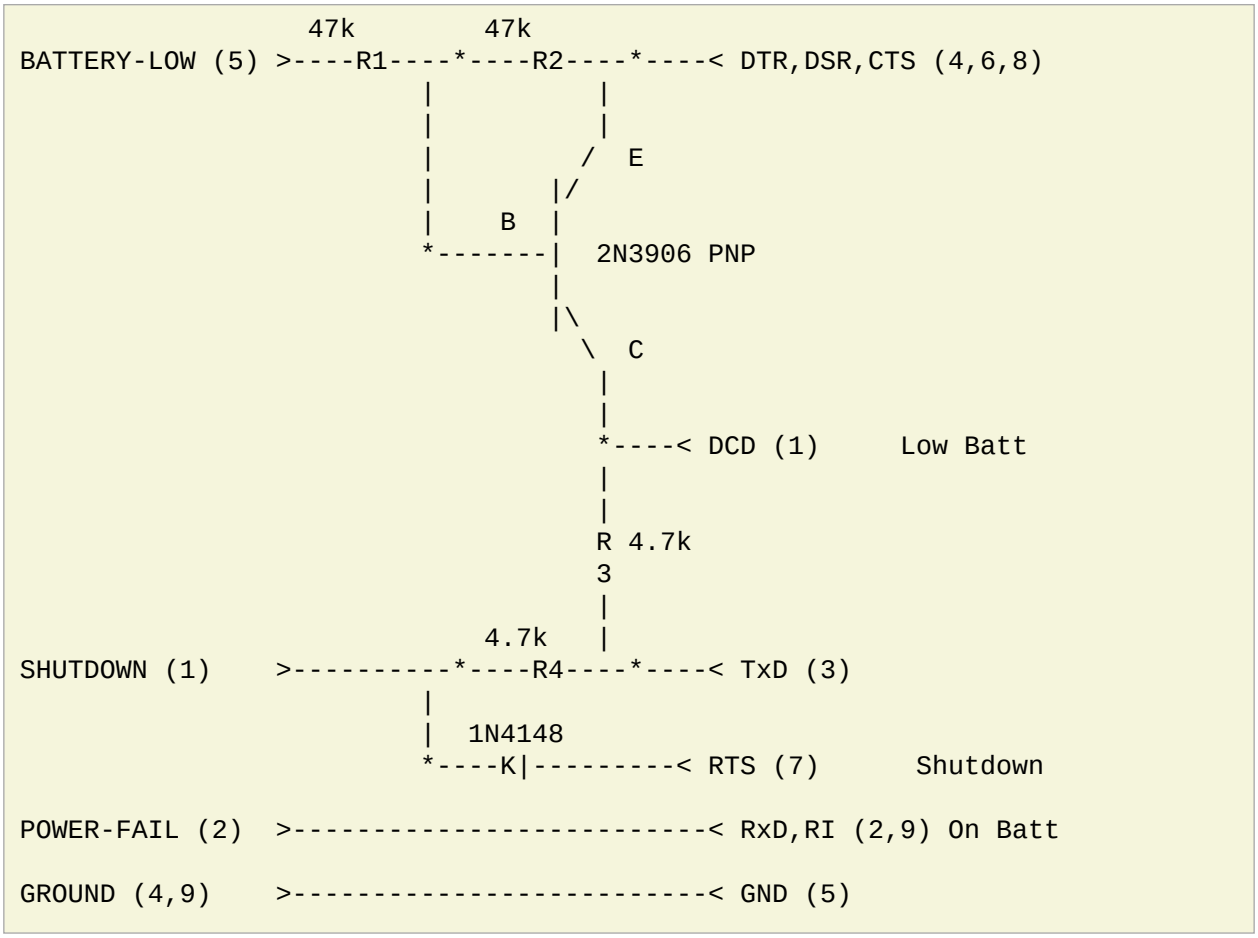
Supported Models: APC BackUPS Pro PNP

Contributed by: Chris Hanson cph at zurich.ai.mit.edu

This is the definitive wiring diagram for the 940-0095A cable submitted by Chris Hanson, who disassembled the original cable, destroying it in the process. He then built one from his diagram and it works perfectly.

```
APC Part# - 940-0095A

UPS end                                        Computer end
-------                                        ------------
```



Operation:

- DTR is "cable power" and must be held at SPACE. DSR or CTS may be used as a loopback input to determine if the cable is plugged in.
- DCD is the "battery low" signal to the computer. A SPACE on this line means the battery is low. This is signalled by BATTERY-LOW being pulled down (it is probably open circuit normally).

  Normally, the transistor is turned off, and DCD is held at the MARK voltage by TxD. When BATTERY-LOW is pulled down, the voltage divider R2/R1 biases the transistor so that it is turned on, causing DCD to be pulled up to the SPACE voltage.
- TxD must be held at MARK; this is the default state when no data is being transmitted. This sets the default bias for both DCD and SHUTDOWN. If this line is an open circuit, then when BATTERY-LOW is signalled, SHUTDOWN will be automatically signalled; this would be true if the cable were plugged in to the UPS and not the computer, or if the computer were turned off.
- RTS is the "shutdown" signal from the computer. A SPACE on this line tells the UPS to shut down.
- RxD and RI are both the "power-fail" signals to the computer. A MARK on this line means the power has failed.
- SPACE is a positive voltage, typically +12V. MARK is a negative voltage, typically -12V. Linux appears to translate SPACE to a 1 and MARK to a 0.

940-0095B Cable Wiring

Supported Models: Many simple-signaling (aka voltage signaling) models such as BackUPS

This diagram is for informational purposes and may not be complete. We don't recommend that use it to build you build one yourself.

```
APC Part# - 940-0095B

Signal Computer                  UPS
       DB9F                     DB9M
 DTR    4   ----*
 CTS    8   ----|
 DSR    6   ----|
 DCD    1   ----*
 GND    5   ---------------*----  4  Ground
                           |
                           *----  9  Common
 RI     9   ----*
                |
 RxD    2   ----*---------------  2  On Battery
 TxD    3   ----------[####]----  1  Kill UPS Power
                       4.7K ohm
```

940-0119A Cable Wiring

Supported Models: Older BackUPS Office

This diagram is for informational purposes and may not be complete. We don't recommend that use it to build you build one yourself.

```
APC Part# - 940-0119A

  UPS      Computer
  pins     pins      Signal             Signal meaning
1 (brown)    4,6      DSR DTR     <-   Shutdown when set by computer for 1-5 seconds.
2 (black)    8,9      RI  CTS     ->   On battery power
3 (blue)     1,2      CD  RxD     ->   Low battery
4 (red)       5       Ground
5 (yellow)    7       RTS         <-   Begin signalling on other pins
6 (none)     none
```

Serial BackUPS ES Wiring

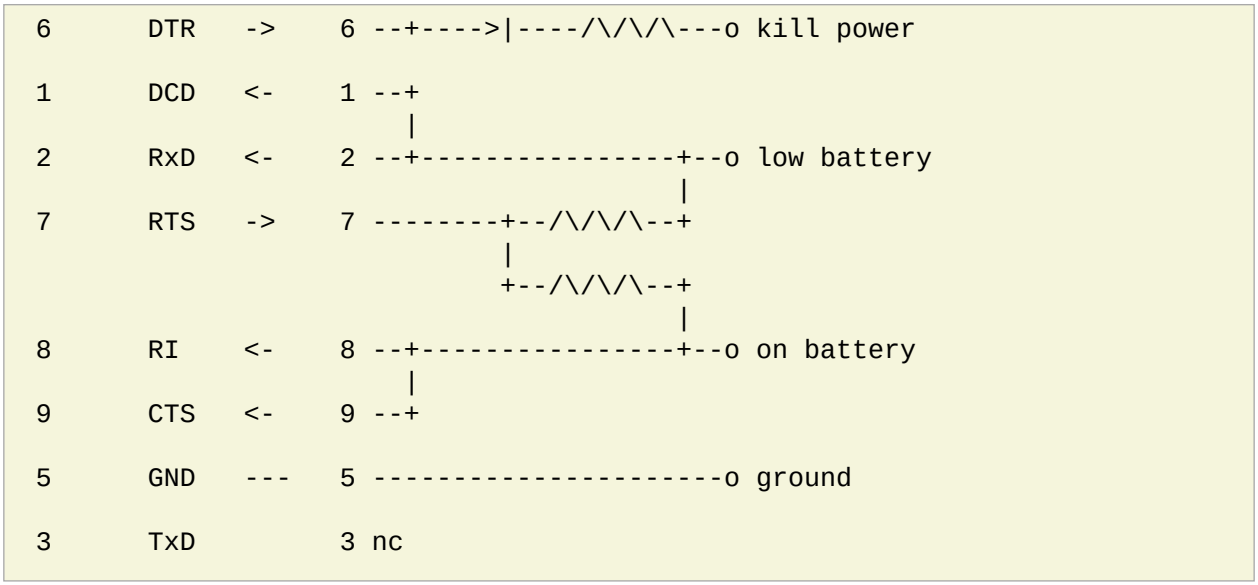
Supported Models: Older Serial BackUPS ES

Contributed by: William Stock

The BackUPS ES has a straight through serial cable with no identification on the plugs. To make it work with apcupsd, specify the { UPSCABLE 940-0119A} and { UPSTYPE backups}. The equivalent of cable 940-0119A is done on a PCB inside the unit.

```
computer           ----------- BackUPS-ES -----------------
DB9-M              DB-9F
pin    signal      pin

 4      DSR   ->    4 --+
                         |  diode   resistor
```

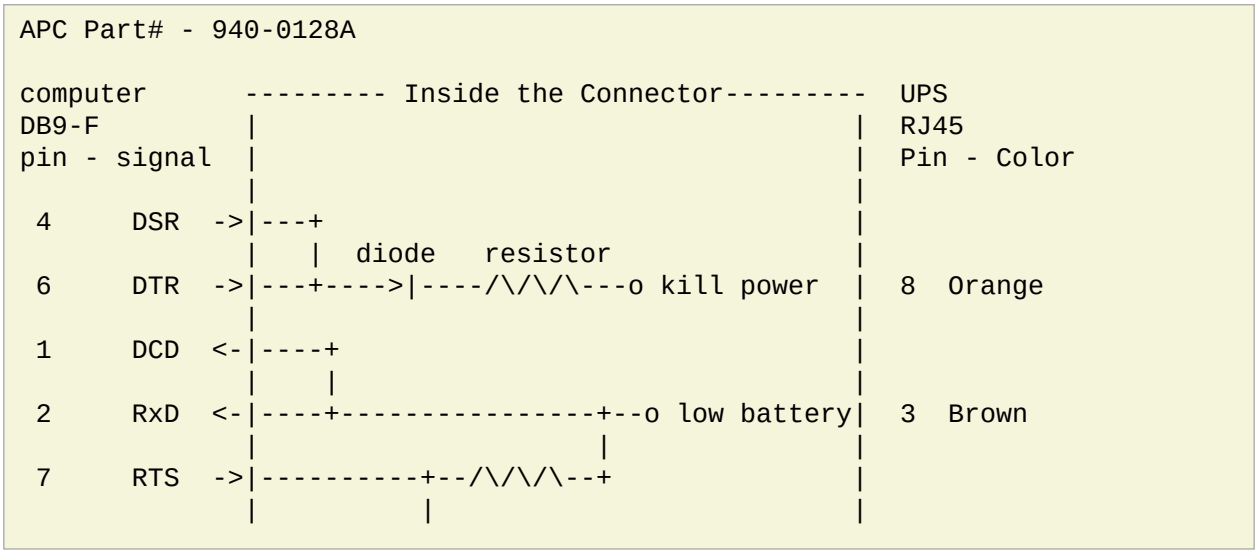


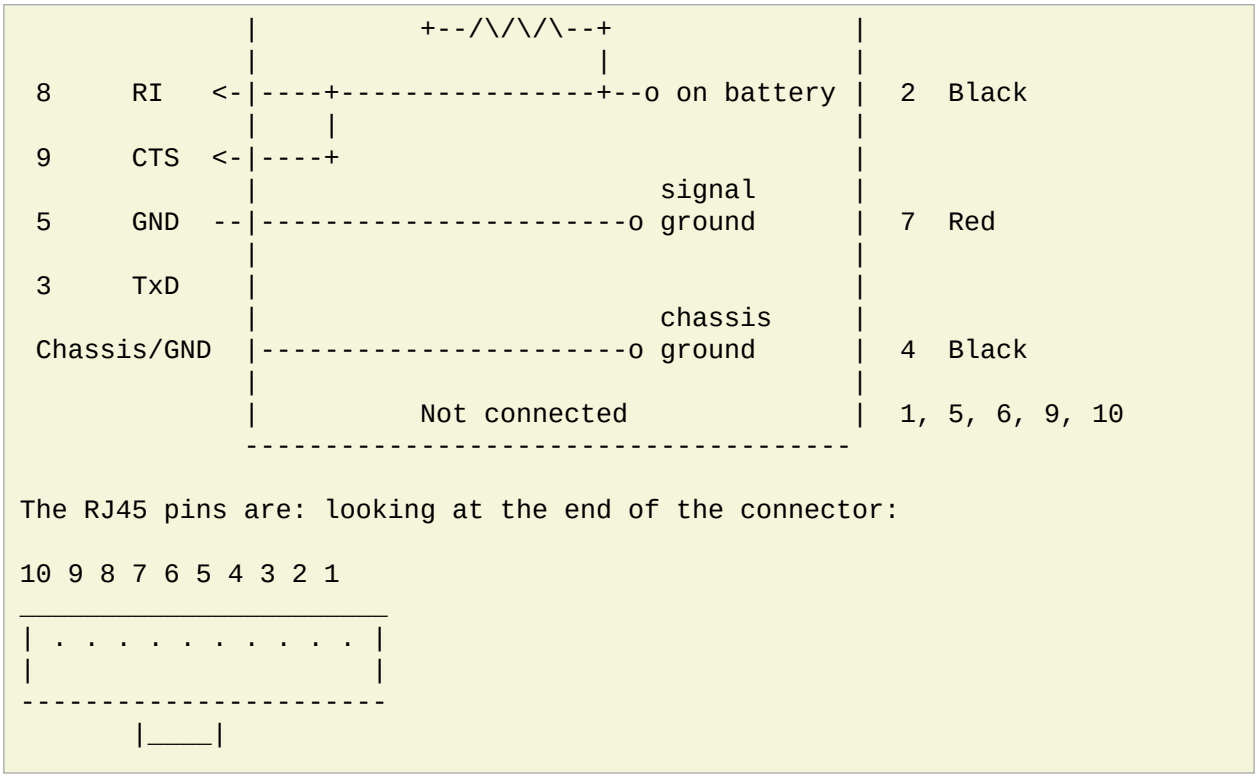
940-0128A Cable Wiring

Supported Models:	Older USB BackUPS ES and CS
Contributed by:	Many, thanks to all for your help!

Though these UPSes are USB UPSes, APC supplies a serial cable (typically with a green DB9 F connector) that has 940-0128A stamped into one side of the plastic serial port connector. The other end of the cable is a 10 pin RJ45 connector that plugs into the UPS (thanks to Dean Waldow for sending a cable!). Apcupsd version 3.8.5 and later supports this cable when specified as { UPSCABLE 940-0128A} and { UPSTYPE dumb}. However, running in this mode much of the information that would be available in USB mode is lost. In addition, when apcupsd attempts to instruct the UPS to kill the power, it begins cycling about 4 times a second between battery and line. The solution to the problem (thanks to Tom Suzda) is to unplug the UPS and while it is still chattering, press the power button (on the front of the unit) until the unit beeps and the chattering stops. After that the UPS should behave normally and power down 1-2 minutes after requested to do so.

Thanks to all the people who have helped test this and have provided information on the cable wiring, our best guess for the cable schematic is the following:



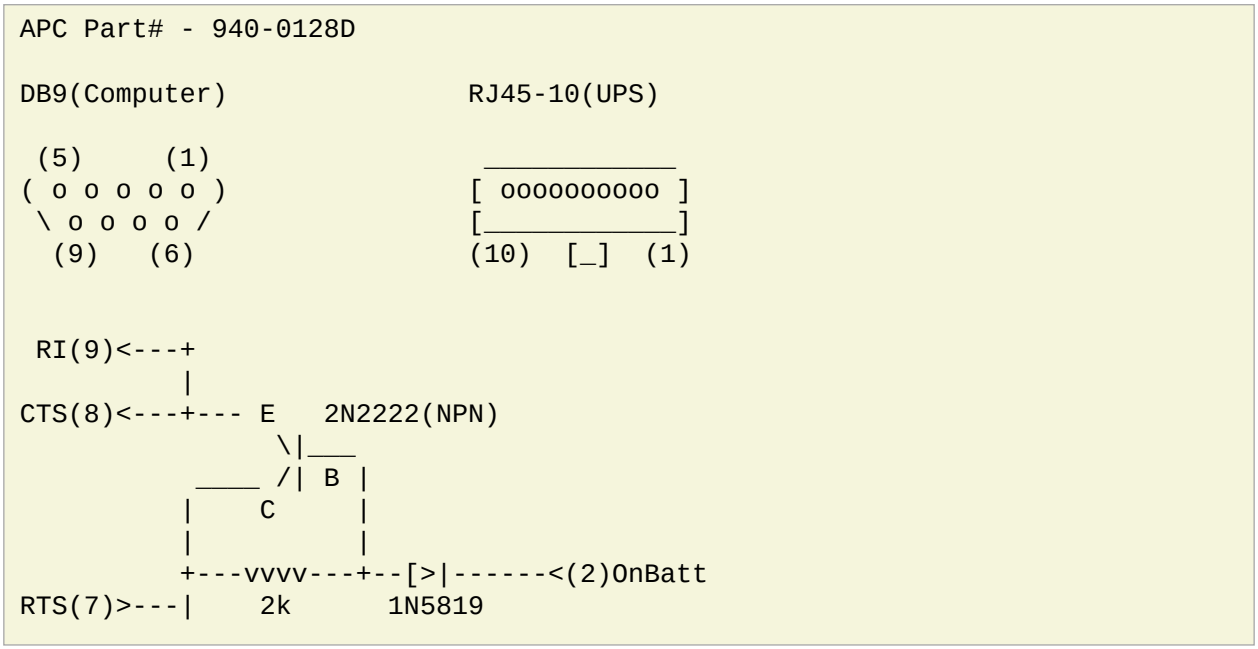

+--/\/\/\--+
8 RI <-|----+----------+--o on battery | 2 Black
9 CTS <-|----+ |
signal |
5 GND --|----------o ground | 7 Red
3 TxD |
chassis |
Chassis/GND |----------o ground | 4 Black
Not connected | 1, 5, 6, 9, 10
The RJ45 pins are: looking at the end of the connector:
10 9 8 7 6 5 4 3 2 1

940-0128D Cable Wiring

Supported Models:	BackUPS XS1000(BX-1000), Possibly other USB models
Contributed by:	Jan Babinski jbabinsk at pulsarbeacon dot com

940-0128D is functionally similar to the 940-0128A cable except for NC on (6) DTR and (2) RD on the computer side.

Unverified: Try setting apcupsd to `UPSTYPE dumb` and `UPSCABLE 940-0128A`.



```
          +---vvvv---+--[>|------<(3)LowBatt
          |          |
          +--- C     |
                \|___|
                /| B
DCD(1)<------- E    2N2222(NPN)

DTR(4)>------------------------->(8)KillPwr

GND(5)---------------------------(7)Signal GND
(Shield)-------------------------(4)Chassis GND
```

940-0127B Cable Wiring

Supported Models:	BackUPS XS1000(BX-1000), Possibly other USB models
Contributed by:	Jan Babinski jbabinsk at pulsarbeacon dot com

Standard USB cable for USB-capable models with 10-pin RJ45 connector.

```
APC Part# - 940-0127B

USB(Computer)      RJ45-10(UPS)
 _________          ____________
| = = = = |        [ ooooooooo ]
|_________|        [____________]
 (1)   (4)         (10)  [_]  (1)

  +5V(1)-----------(1)+5V
DATA+(2)-----------(9)DATA+
DATA-(3)-----------(10)DATA-
  GND(4)-----------(7)Signal GND
(Shield)-----------(4)Chassis GRND
```

Win32 Implementation Restrictions for Simple UPSes

Due to inadequacies in the Win32 API, it is not possible to set/clear/get all the serial port line signals. apcupsd can detect: CTS, DSR, RNG, and CD. It can set and clear: RTS and DTR.

This imposes a few minor restrictions on the functionality of some of the cables. In particular, LineDown on the Custom Simple cable, and Low Battery on the 0023A cable are not implemented.

Recalibrating the UPS Runtime

Note: In a future release of apcupsd this procedure will be replaced by a daemon operation that can be performed on all types of UPS.

This section does not apply to voltage-signalling or dumb UPSes such as the older BackUPS models.

Smart UPSes internally compute the remaining runtime, and apcupsd uses the value supplied by the UPS. As the batteries age (after say two or three years), the runtime computation may no longer be accurate since the batteries no longer hold the same charge. As a consequence, in the event of a power failure, the UPS and thus apcupsd can report a runtime of 5 minutes remaining when in fact only one minute remains. This can lead to a shutdown before you might expect it, because regardless of the runtime remaining that is reported, the UPS will always correctly detect low batteries and report it, thus causing apcupsd to correctly shutdown your computer.

If you wish to have the UPS recalibrate the remaining runtime calculations, you can do so manually as the current version of apcupsd does not support this feature. To do so,

- Shutdown apcupsd
- contact your UPS directly using some terminal program such as minicom, tip, or cu with the settings 2400 8N1 (2400 baud, 8 bits, no parity, 1 stop bit). Be extremely careful what you send to your UPS as certain characters may cause it to power down or may even cause damage to the UPS. Try sending an upper case `Y` to the UPS (without a return at the end). It should respond with `SM`. If this is not the case, read the chapter on testing. If you fat finger the `Y` and enter `y` instead, no cause for alarm, you will simply get the APC copyright notice.
- when you are sure you are properly connected send an upper case D (no cr). This will put the UPS into calibration mode, and it will drain the battery down to 25% capacity (35% for a Matrix) at which point it will go back on the mains. In doing so, it will recompute the runtime calibration.
- If you wish to abort the calibration, enter a second D command.
- When you are done, restart apcupsd.

In principle, you should be able to do this with the computer powered by the UPS, but if you wish to be completely safe, you should plug your computer into the wall prior to performing the runtime calibration. In that case, you will need to artificially load the UPS with light bulbs or other means. You should supply a load of about 30 to 35% but not more than 50%. You can determine the load by looking at the output of the `apcaccess status` command while apcupsd is running.

You should not run the recalibration command more than once or twice per year as discharging these kinds of batteries tends to shorten their life span.

Configuration Directive Reference

Configuration directives in /etc/apcupsd/apcupsd.conf control the behavior of the apcupsd daemon. For most installations it is only necessary to set a handful of general directives. The rest can be left at their defaults unless you have an exotic configuration.

Note that the apcupsd daemon must be restarted in order for changes to the configuration file to become active.

General Configuration Directives

In general, each of these directives is required (except that the `DEVICE` directive is ignored for `UPSCABLE ether` and not required for `UPSCABLE usb`).

UPSTYPE *driver*

The name of a driver. Should be one of `dumb`, `apcsmart`, `net`, `usb`, `pcnet`, `snmp`, or `test`. This describes your interface type. The UPSTYPE directive can be defined during installation by using the `--with-upstype=` option of the `configure` program.

UPSCABLE *cable*

Defines the type of cable connecting the UPS to your computer.

Possible generic choices for <cable> are:

`simple`, `smart`, `ether`, `usb`

Or a specific cable model number may be used:

`940-0119A`, `940-0127A`, `940-0128A`, `940-0020B`, `940-0020C`, `940-0023A`, `940-0024B`, `940-0024C`, `940-1524C`, `940-0024G`, `940-0095A`, `940-0095B`, `940-0095C`, `M-04-02-2000`

The `--with-upscable=` option of `configure` can be used to set a default for this directive during the your build.

DEVICE *device*

Specify which device is used for UPS communications. For serial ports, it is usually something like /dev/ttyS0. For USB ports, you may leave the name of the device blank (no specification) and apcupsd will automatically search the standard locations for the UPS.

Normally, the `configure` program will set an appropriate default value. You may also specify the `--with-serial-dev=` option of the `configure` program to set this directive at build time.

If you have specified `UPSTYPE net`, then the device name to be specified consists of *hostname:port* where the *hostname* is the fully qualified name or IP address of the host (NIS server) and the *port* (optional) is the port to use to contact the server.

If you specified `UPSTYPE snmp`, then the device name becomes *hostname:vendor:community*. Please see the Support for SNMP UPSes chapter in this manual for more details.

POLLTIME ***time in seconds***

The interval, in seconds, at which apcupsd polls the UPS for status. This rate is automatically set to 1 second if the UPS goes on batteries and reset to your specified value when the mains power returns. This setting applies both to directly-attached UPSes (`UPSTYPE apcsmart`, `usb`, `dumb`) and networked UPSes (`UPSTYPE net`, `snmp`). Lowering this setting will improve apcupsd's responsiveness to certain events at the cost of higher CPU utilization. The default of 60 is appropriate for most situations. This directive was formerly known as `NETTIME`.

LOCKFILE ***path to lockfile***

This option tells apcupsd where to create a lockfile for the USB or serial port in the specified directory. This is important to keep two programs from reading or writing the port at the same time. Please note that although the directive name is LOCKFILE, you are actually specifying the lock file path. apcupsd automatically appends the name of the device when creating the file. On most systems, this directive is automatically set by the `./configure` program. You may also explicitly set it during the build process by using the `--with-lock-dir=` option of the `configure` program.

Configuration Directives Used by the Network Information Server

None of these directives are required for proper operation of apcupsd.

NETSERVER ***[on | off]***

This configuration directive turns the network information server on or off. If it is on, apcupsd will spawn a child process that serves STATUS and EVENTS information over the network. This information is currently used by the Web-based CGI programs. The default is on. *This option is required to be turned on for net clients and apcaccess to function.*

NISIP ***IP-address***

This directive specifies the IP address of the network interface on which the NIS server will listen for incoming connections. Default value is 0.0.0.0 which means the NIS will listen for connections on all network interfaces. If your machine has more than one interface, you can specify the IP of a single interface to limit connections to only that interface. Furthermore, you can specify the loopback address (127.0.0.1) to accept connections only from the local machine. You may also use the `--with-nisip=` option of the `configure` program to set this directive during the build.

NISPORT ***port***

This configuration directive specifies the port to be used by the apcupsd Network Information Server. The default is platform dependent, but typically 3551, which we have received from IANA as the official apcupsd networking port. This value should only be changed if it conflicts with an existing service in use on your network or if you are running multiple instances of apcupsd on the same machine.

EVENTSFILE ***filename***

If you want the apcupsd network information server to provide the last 10 events via the network, you must specify a file where apcupsd will save these events. The default is: /etc/apcupsd/apcupsd.events. Currently, apcupsd will save at most the last 50 events. Periodically (once an hour by default), apcupsd will check the size of this file. When more than 50 events are recorded, apcupsd will truncate the file to the most recent 10 events. Consequently this file will not grow indefinitely. Although we do not recommend it, you may change these values by editing

apcevents.c and changing the appropriate defines. Be aware that if you set these values to very large numbers, apcupsd may make excessive memory demands on the system during the data access and file truncation operations.

This filename may also be specified at build time by using the `--with-log-dir=` option of the `configure` program.

Configuration Directives used during Power Failures

In general, none of these directives are required. However, if you have a voltage-signalling (dumb) UPS with a cable that does not support the Low Battery signal, you must set the `TIMEOUT` directive to force a shutdown.

BATTERYLEVEL ***percent of battery***

If `BATTERYLEVEL` is specified, during a power failure, apcupsd will halt the system when the remaining battery charge falls below the specified percentage. The default is 5 percent. This directive is ignored for dumb (voltage-signalling) UPSes. To totally disable this counter, set `BATTERYLEVEL -1` in your apcupsd.conf file.

MINUTES ***battery runtime in minutes***

If `MINUTES` is specified, during a power failure, apcupsd will shutdown the system when the remaining runtime on batteries as internally calculated by the UPS falls below the time specified. The default is 3. This directive is ignored for dumb (voltage-signalling) UPSes. It should be noted that some UPSes report an incorrect value for remaining runtime when the battery is fully charged. This can be checked by examining the `TIMELEFT` value as printed in the output of an '`apcaccess status`' command. If the value is zero or otherwise unreasonable, your UPS is probably broken. In this case, we recommend that you disable this timer by setting `MINUTES -1` in your apcupsd.conf file.

TIMEOUT ***time in seconds***

After a power failure, apcupsd will halt the system when `TIMEOUT` seconds have expired. A value of zero disables this timer. Normally for all Smart UPS models and dumb UPSes with cables that support low battery detection, this should be zero so that the shutdown time will be determined by the battery level and/or remaining runtime (see above) or in the case of a voltage-signalling UPS, when the battery is exhausted. This command is required for dumb UPSes that do not provide a battery exhausted signal (only testing can determine this point). For more information, see the Testing Apcupsd section of this manual. This timer can also be useful if you want some slave machines to shutdown before other machines to conserve battery power. It is also useful for testing apcupsd because you can force a rapid shutdown by setting a small value (e.g. 60) and pulling the plug to the UPS.

`TIMEOUT`, `BATTERYLEVEL`, and `MINUTES` can be set together without problems. apcupsd will react to the first case or test that is valid. Normally SmartUPS users will set `TIMEOUT` to zero so that the system is shutdown depending on the percentage battery charge remaining (`BATTERYLEVEL`) or the remaining battery runtime (`MINUTES`).

ANNOY ***time in seconds***

Specify the time in seconds between messages requesting logged in users to get off the system during a power failure. This timer starts only when the UPS is running on batteries. The default is 300 seconds (5 minutes). apcupsd sends the annoy messages by invoking the apccontrol script with the `annoyme` argument. The default is to send a wall message on Unix systems and a popup message in Windows.

The value of `ANNOYDELAY` must be greater than the value of `ANNOY` in order to receive annoy messages (this doesn't make sense, and means that the default values do not generate annoy messages: KES).

Note that if `NOLOGON disable` is set, the annoy messages will also be disabled.

ANNOYDELAY ***time in seconds***

Specify delay time in seconds before apcupsd begins requesting logged in users to get off the system during a power failure. This timer starts only after the UPS is running on batteries. This timer

is reset when the power returns. The default is 60 seconds. Thus, the first warning to log off the system occurs after 60 seconds on batteries, assuming that NOLOGON is not set to disable.

NOLOGON *disable* | *timeout* | *percent* | *minutes* | *always*

Specifies when apcupsd should prevent user logins
The type specified allows you define the point when apcupsd will create the 'nologin' file and thus when user logins are prohibited. Once the 'nologin' file is created, normal users are prevented from logging in. Control of when this file is created is important for allowing systems with big UPSes to run as normally until the system administrator determines the need for preventing user logins. The feature also allows the system administrator to hold the "ANNOY" factor until the 'nologin' file is created. The default is always disable if no NOLOGON directive is specified.
The 'nologin' file will be created in the directory specified by the NOLOGINDIR directive described below.
As far as I can tell, the only useful types are disable and always since the difference in the time when the logout warning is given and shutdown occurs for the other types is very short (KES).

disable prevents apcupsd from creating the nologin file. Consequently, any user can login during a power failure condition. Also, the ANNOY feature is disabled so users will not be warned to logoff the system.

timeout specifies that apcupsd should prohibit logins after the UPS is on batteries for 90% of the time specified on the TIMEOUT configuration directive. Note! Normally you don't want to specify a TIMEOUT value, so this option is probably not too useful (KES).

percent specifies that apcupsd should prohibit logins when the remaining battery charge percentage reaches 110% or less than the value specified on the BATTERYLEVEL configuration directive. Thus if the BATTERYLEVEL is specified as 15, apcupsd will prohibit logins when the battery charge drops below 16% (15% X 110% = 16%).

minutes specifies that apcupsd should prohibit logins when the remaining runtime in minutes reaches 110% or less than the value specified on the MINUTES configuration directive. Thus if MINUTES is set to 3, apcupsd will prohibit logins when the remaining runtime is less than 3 minutes (3 X 110% = 3).

always causes apcupsd to immediately prohibit logins when a power failure occurs. This will also enable the ANNOY feature.

NOLOGINDIR *path to nologin dir*

This directive configures the directory into which apcupsd will write the nologin file, as described above for the NOLOGON directive.
Normally, the configure program will set an appropriate default value for your platform, often /etc. You may also specify the --with-nologdir= option of the configure program to change the default at compile time.

KILLDELAY *time in seconds*

If KILLDELAY is set, apcupsd will continue running after a shutdown has been requested, and after the specified time in seconds, apcupsd will attempt to shut off the UPS the power. This directive should normally be disabled by setting the value to zero, but on some systems such as Win32 systems apcupsd cannot regain control after a shutdown to force the UPS to shut off the power. In this case, with proper consideration for the timing, the KILLDELAY directive can be useful. Please be aware, if you cause apcupsd to kill the power to your computer too early, the system and the disks may not have been properly prepared. In addition, apcupsd must continue running after the shutdown is requested, and on Unix systems, this is not normally the case as the system will terminate all processes during the shutdown.

SCRIPTDIR *path to apccontrol dir*

This option configures the directory in which apccontrol and other event scripts are located.
Normally, the configure program will set an appropriate default value for your platform, often /etc/apcupsd.

PWRFAILDIR *path to powerfail dir*

When apcupsd shuts down your system, it creates a temporary "flag file" which is used by the operating system halt scripts to know if this shutdown is due to a power failure. This directive configures which directory the flag file will be written into. The chosen directory must be writable by the user apcupsd is running as (normally root) and must not be cleared or unmounted early in the shutdown sequence.
Normally, the `configure` program will set an appropriate default value for your platform, often /etc/apcupsd. You may also specify the `--with-pwrfaildir=` option of the `configure` program to change the default at compile time.

Configuration Directives used to Control System Logging

STATTIME ***time in seconds***

This directive supplies the time interval in seconds between writes to the STATUS file. If set to zero, the STATUS file will not be written. Please note that in a future version of apcupsd the STATUS file code will disappear since its functionality has been replaced by the Network Information Server and by `apcaccess status`, as a consequence, it is normally disabled by setting it to zero.

STATFILE ***file***

This directive specifies the file to be used when writing the STATUS information. The default is /etc/apcupsd/apcupsd.status.

DATATIME ***time in seconds***

This directives supplies the time interval in seconds between writes of PowerChute-like data information to the log file. See the DATA Logging section of this manual for additional details.

FACILITY ***log-facility***

The `FACILITY` directive can be used to change the system logging class or facility. The default is `DAEMON`. This parameter can be useful if you wish to direct the apcupsd system logging information to other than your system default files. See the apcupsd System Logging section of this manual for additional details.

Configuration Directives for Sharing a UPS

The following directives apply to sharing an UPS using a ShareUPS hardware module. Most users will not use this mode.

UPSCLASS *standalone* | *shareslave* | *sharemaster*

The default is `standalone` and should be used for all machines powered by the UPS and having a serial port or other direct connection to the UPS. This is the normal case.

Use `shareslave` if and only if you are using a ShareUPS and connected to a BASIC Port with Simple Signal. This code is not fully tested.

Use `sharemaster`, if and only if you are using a ShareUPS and connected to the ADVANCED Port Smart Signal control. This code is not fully tested.

UPSMODE *disable* | *share*

For normal standalone operations, you will set `UPSMODE disable` to indicate that you are disabling the ShareUPS support.

Use `share` for two or seven additional simple signal ports on a SmartAccessories(tm) (internal/external box) for SmartUPSes. The share and sharenet code is not fully tested.

Configuration Directives Used to Set the UPS EEPROM

These directives have no effect on the operation of apcupsd but are reserved for use by apctest when bulk programming the values of the UPS EEPROM configuration variables in a Smart-UPS model.

UPSNAME *<string>*

Name of UPS. Maximum of 8 characters.

BATTDATE [*mm/dd/yy* | *dd/mm/yy*]

Last battery replacement date. Maximum of 8 characters.

SENSITIVITY [*H* | *M* | *L*]

H : High (most sensitive setting) M : Medium L : Low (least sensitive setting)

WAKEUP [*000* | *060* | *180* | *300*]

The time delay in seconds that the UPS waits after the return of utility power before "waking up" and restoring power to the connected equipment.

SLEEP [*020* | *180* | *300* | *600*]

The time delay in seconds for which the UPS waits or "sleeps" after it receives a request to power off the connected system.

LOTRANSFER <*voltage*>

Low line voltage causing transfer to battery power or activation of SmartBoost. Allowable values depend on the last letter of the firmware or APCMODEL. Typical values are:

```
D  106  103  100  097
M  177  172  168  182
A  092  090  088  086
I  208  204  200  196
```

where D = domestic (USA), M = Canada, A = Asia and I = International.

HITRANSFER <*voltage*>

High line voltage causing transfer to battery power or activation of SmartTrim. Allowable values depend on the last letter of the firmware or APCMODEL. Typical values are:

```
D  127  130  133  136
M  229  234  239  224
A  108  110  112  114
I  253  257  261  265
```

where D = domestic (USA), M = Canada, A = Asia and I = International.

RETURNCHARGE [*00* | *15* | *50* | *90*]

Percentage of battery charge needed for the UPS to restore power to the connected equipment.

BEEPSTATE [*0* | *T* | *L* | *N*]

Alarm delay.

```
0 : Zero delay after power fails.
T : When power fails plus 30 seconds.
L : When low battery occurs.
N : Never.
```

LOWBATT <*minutes*>

Low battery warning occurs when the specified number of minutes remains before the UPS estimates battery power will be exhausted. There are four user-changeable settings: 2, 5, 7, or 10 minutes

OUTPUTVOLTS <*voltage*>

UPS nominal output voltage when running on battery. Allowable values depend on the last letter of the firmware or APCMODEL. Typical values are:

```
D  115
M  208
A  100
I  230  240  220  225
```

where D = domestic (USA), M = Canada, A = Asia and I = International.

SELFTEST [*336* | *168* | *ON* | *OFF*]

Self test interval in hours (336 = 2 weeks, 168 = 1 week, ON = at power on, OFF = never).

apcupsd Status Logging

There is a good deal of information available about the UPS and apcupsd's status. This document describes the format of that information. Normally you will get at it via `apcaccess`, but there are other ways as well.

Status report format

STATUS output is in ASCII format with a single data value or piece of information on each line output. Because not all UPSes supply the same information, the output varies based on the type of UPS that you are using. In general, if the information is not available for your UPS, the line will be missing entirely or the data portion of the output record will contain an `N/A` indicating that the information is not available.

Status logging consists of periodically logging ALL available information concerning the UPS. Since the volume of data is rather large (over 1000 bytes per status), the STATUS data is not automatically sent to the system log file. Instead, it is written as a series of data records in a specific file (normally /etc/apcupsd/apcupsd.status).

After each write, the file is rewound so that the size of the file remains constant. The STATUS file is kept for backward compatibility and will be eliminated in a future version of apcupsd. The preferred method for obtaining this information is from apcaccess or by using the CGI interface (see apcupsd Network Monitoring (CGI) Programs).

To make reading the status data reliable via a named pipe, the first record written contains a version number, the number of records that follow the first record, and the total number of bytes in those subsequent records. An actual example of such a status file (/etc/apcupsd/apcupsd.status) is shown below.

Consequently, the first record always consists of 24 bytes (23 characters followed by a newline). This record starts with APC and as indicated in the example is followed by 37 records consisting of 906 bytes. The last record begins with END APC and contains the date and time matching the DATE record.

When this data is written to a file, it is written as two records, the first record, and all the other records together. In reading the file, it can be either be read a record at a time, or in one big read.

When this data is written to syslog(), it is written a record at a time. The first record is the first 24 bytes. By having the number of records and the size in the first record, the complete status can be reliably reassembled.

Status Report Example

An example of output from a BackUPS RS 1500 follows:

```
APC      : 001,037,0906
DATE     : Sun Apr 26 17:22:22 EDT 2009
HOSTNAME : mail.kroptech.com
```

```
VERSION  : 3.14.2 (10 September 2007) redhat
UPSNAME  : ups0
CABLE    : USB Cable
MODEL    : Back-UPS RS 1500
UPSMODE  : Stand Alone
STARTTIME: Sun Apr 26 10:22:46 EDT 2009
STATUS   : ONLINE
LINEV    : 123.0 Volts
LOADPCT  :  24.0 Percent Load Capacity
BCHARGE  : 100.0 Percent
TIMELEFT : 144.5 Minutes
MBATTCHG : 5 Percent
MINTIMEL : 3 Minutes
MAXTIME  : 0 Seconds
SENSE    : Medium
LOTRANS  : 097.0 Volts
HITRANS  : 138.0 Volts
ALARMDEL : Always
BATTV    : 26.8 Volts
LASTXFER : Low line voltage
NUMXFERS : 0
TONBATT  : 0 seconds
CUMONBATT: 0 seconds
XOFFBATT : N/A
SELFTEST : NO
STATFLAG : 0x07000008 Status Flag
MANDATE  : 2003-05-08
SERIALNO : JB0319033692
BATTDATE : 2001-09-25
NOMINV   : 120
NOMBATTV :  24.0
FIRMWARE : 8.g6 .D USB FW:g6
APCMODEL : Back-UPS RS 1500
END APC  : Sun Apr 26 17:22:32 EDT 2009
```

Status Report Fields

The meaning of the above variables are:

APC

Header record indicating the STATUS format revision level, the number of records that follow the APC statement, and the number of bytes that follow the record.

DATE

The date and time that the information was last obtained from the UPS.

HOSTNAME

The name of the machine that collected the UPS data.

UPSNAME

The name of the UPS as stored in the EEPROM or in the `UPSNAME` directive in the configuration file.

VERSION

The apcupsd release number, build date, and platform.

CABLE

The cable as specified in the configuration file (`UPSCABLE`).

MODEL

The UPS model as derived from information from the UPS.

UPSMODE

The mode in which apcupsd is operating as specified in the configuration file (`UPSMODE`)

STARTTIME

The time/date that apcupsd was started.

STATUS

The current status of the UPS (ONLINE, ONBATT, etc.)

LINEV

The current line voltage as returned by the UPS.

LOADPCT

The percentage of load capacity as estimated by the UPS.

BCHARGE

The percentage charge on the batteries.

TIMELEFT

The remaining runtime left on batteries as estimated by the UPS.

MBATTCHG

If the battery charge percentage (BCHARGE) drops below this value, apcupsd will shutdown your system. Value is set in the configuration file (`BATTERYLEVEL`)

MINTIMEL

apcupsd will shutdown your system if the remaining runtime equals or is below this point. Value is set in the configuration file (`MINUTES`)

MAXTIME

apcupsd will shutdown your system if the time on batteries exceeds this value. A value of zero disables the feature. Value is set in the configuration file (`TIMEOUT`)

MAXLINEV

The maximum line voltage since the UPS was started, as reported by the UPS

MINLINEV

The minimum line voltage since the UPS was started, as returned by the UPS

OUTPUTV

The voltage the UPS is supplying to your equipment

SENSE

The sensitivity level of the UPS to line voltage fluctuations.

DWAKE

The amount of time the UPS will wait before restoring power to your equipment after a power off condition when the power is restored.

DSHUTD

The grace delay that the UPS gives after receiving a power down command from apcupsd before it powers off your equipment.

DLOWBATT

The remaining runtime below which the UPS sends the low battery signal. At this point apcupsd will force an immediate emergency shutdown.

LOTRANS

The line voltage below which the UPS will switch to batteries.

HITRANS

The line voltage above which the UPS will switch to batteries.

RETPCT

The percentage charge that the batteries must have after a power off condition before the UPS will restore power to your equipment.

ITEMP

Internal UPS temperature as supplied by the UPS.

ALARMDEL

The delay period for the UPS alarm.

BATTV

Battery voltage as supplied by the UPS.

LINEFREQ

Line frequency in hertz as given by the UPS.

LASTXFER

The reason for the last transfer to batteries.

NUMXFERS

The number of transfers to batteries since apcupsd startup.

XONBATT

Time and date of last transfer to batteries, or N/A.

TONBATT

Time in seconds currently on batteries, or 0.

CUMONBATT

Total (cumulative) time on batteries in seconds since apcupsd startup.

XOFFBATT

Time and date of last transfer from batteries, or N/A.

SELFTEST

The results of the last self test, and may have the following values:

- OK: self test indicates good battery
- BT: self test failed due to insufficient battery capacity
- NG: self test failed due to overload
- NO: No results (i.e. no self test performed in the last 5 minutes)

STESTI

The interval in hours between automatic self tests.

STATFLAG

Status flag. English version is given by STATUS.

DIPSW

The current dip switch settings on UPSes that have them.

REG1

The value from the UPS fault register 1.

REG2

The value from the UPS fault register 2.

REG3

The value from the UPS fault register 3.

MANDATE

The date the UPS was manufactured.

SERIALNO

The UPS serial number.

BATTDATE

The date that batteries were last replaced.

NOMOUTV

The output voltage that the UPS will attempt to supply when on battery power.

NOMINV

The input voltage that the UPS is configured to expect.

NOMBATTV

The nominal battery voltage.

NOMPOWER

The maximum power in Watts that the UPS is designed to supply.

HUMIDITY

The humidity as measured by the UPS.

AMBTEMP

The ambient temperature as measured by the UPS.

EXTBATTS

The number of external batteries as defined by the user. A correct number here helps the UPS compute the remaining runtime more accurately.

BADBATTS

The number of bad battery packs.

FIRMWARE

The firmware revision number as reported by the UPS.

APCMODEL

The old APC model identification code.

END APC

The time and date that the STATUS record was written.

Logging the STATUS Information

If specified in the configuration file, the STATUS data will also be written to the system log file. Please note, that it would not normally be wise to write this data to a normal system log file as there is no mechanism in syslog() to rewind the file and hence the log file would quickly become enormous. However, in two cases, it can be very useful to use syslog() to write this information.

The first case is to set up your syslog.conf file so that the data is written to a named pipe. In this case, normally not more than about 8192 bytes of data will be kept before it is discarded by the system.

The second case is to setup your syslog.conf file so that the status data is sent to another machine, which presumably then writes it to a named pipe. Consequently, with this mechanism, provides a simple means of networking apcupsd STATUS information.

Although we mention system logging of STATUS information, we strongly recommend that you use apcaccess or the CGI interface to get this information.

The Shutdown Sequence and its Discontents

Shutdown Sequence

If you experienced so problems with the testing procedures, or if you are porting apcupsd to another system, or you are simply curious, you may want to know exactly what is going on during the shutdown process.

The shutdown sequence is as follows:

- apcupsd detects that there is a power problem and it calls `/etc/apcupsd/apccontrol powerout`. By default this event does nothing, but it can be overridden to notify users, etc.
- After the configured `ONBATTERYDELAY`, apcupsd calls `/etc/apcupsd/apccontrol onbattery`, which normally sends a message to all users informing them that the UPS is on batteries.
- When one of the conditions listed below occurs, apcupsd issues a shutdown command by calling `/etc/apcupsd/apccontrol doshutdown`, which should perform a shutdown of your system using the system shutdown(8) command. You can modify the behavior as described in Customizing Event Handling.

  The conditions that trigger the shutdown can be any of the following:

  - Running time on batteries have expired (`TIMEOUT`)
  - The battery runtime remaining is below the configured value (`BATTERYLEVEL`)
  - The estimated remaining runtime is below the configured value (`MINUTES`)
  - The UPS signals that the batteries are exhausted.

  A shutdown could also be initiated if apcupsd detects that the batteries are no longer functioning correctly. This case, though very unusual, can happen at any time even if there is proper mains voltage, and `/etc/apcupsd/apccontrol emergency` is called.

  Just before initiating any shutdown through the apccontrol script, apcupsd will create the file /etc/apcupsd/powerfail. This file will be used later in the shutdown sequence to recall apcupsd after syncing of the disks to initiate a power off of the UPS.

  If the /etc/nologin file has not already been created, it will normally be created during the shutdown sequence to prevent additional users from logging in (see the `NOLOGIN` configuration directive).

  Even though apcupsd has requested the system to perform a shutdown, it continues running.
- When the system signals apcupsd to do exit, it does so. This is part of the normal system shutdown (at least on Unix and Linux systems) and the exact time that apcupsd receives the termination signal depends on how the shutdown links (usually in /etc/rc.d) are set.

  Note that on Windows NT systems, apcupsd apparently continues to run as a Service even though the machine is "shutdown".
- During the shutdown of the system after apcupsd has been forced to exit, one of the last things done by the system shutdown is to call the halt script, which is usually in /etc/rc.d/halt or /etc/rc.d/init.d/halt, or possibly in /sbin/init.d/rc.0 depending on your system. If apcupsd was properly installed, this standard halt script was modified to include a bit of new logic just before the final halt of the system. It first tests if the file /etc/apcupsd/powerfail exists, and if it does, it executes `/etc/apcupsd/apccontrol killpower`. It is this last step that will cause apcupsd to be re-executed with the `--killpower` option on the command line. This option tells apcupsd to inform the UPS to kill the power.

This final step is important if you want to ensure that your system will automatically reboot when the power comes back on. The actual code used on the Red Hat version is:

```
# See if this is a powerfail situation.                                  # ***apcupsd***
if [ -f /etc/apcupsd/powerfail ]; then                                   # ***apcupsd***
  echo                                                                   # ***apcupsd***
  echo "APCUPSD will now power off the UPS"                              # ***apcupsd***
  echo                                                                   # ***apcupsd***
  /etc/apcupsd/apccontrol killpower                                      # ***apcupsd***
  echo                                                                   # ***apcupsd***
  echo "Please ensure that the UPS has powered off before rebooting"     # ***apcupsd***
  echo "Otherwise, the UPS may cut the power during the reboot!!!"       # ***apcupsd***
  echo                                                                   # ***apcupsd***
fi                                                                       # ***apcupsd***
```

The above code must be inserted as late as possible in the halt script. On many systems, such as Red Hat, all the disk drives were unmounted, then remounted read-only, thus permitting access to the /etc files and the apcupsd executable. If your system does not explicitly remount the disks, you must remount them in read-only mode in the code that you add. Examples of code fragments that do this can be found in the distributions/suse subdirectory of the source.

If you are not able to insert the above code in your halt script because there is no halt script, or because your halt script calls the init program as some Unix systems do, you can either just forget about powering off the UPS, which means that your machine will not automatically reboot after a power failure, or there is yet another alternative, though not at all as satisfying as inserting code in the halt script.

Only if you cannot insert the appropriate code in the halt script, when you start apcupsd, normally from the /etc/rc.d/init.d/apcupsd script, use the `--kill-on-powerfail` option. This will cause apcupsd to program the UPS to shutoff the power just before it (apcupsd) does the system shutdown. Please note that this is not the most ideal solution. Read on to understand why.

A very important consideration is that you must set the EEPROM in your UPS so that it waits a sufficient time for the system to halt before it shuts off the UPS power.

When using a USB connection, apcupsd automatically sets this value to 60 seconds. When using a serial connection to a SmartUPS, you must configure the value in the UPS EEPROM by hand using `apctest`.

Shutdown Problems

Obviously if your halt script is not properly modified, apcupsd will not be able to shut off the power to the UPS, and if the power returns before the batteries are exhausted your system will not automatically reboot. In any case, your machine should have been cleanly shut down.

Master/Slave Shutdown

In master/slave configurations, however, the master cannot be 100 percent sure that the slaves have all shutdown before it performs the power off. To avoid this situation, be sure to configure any slaves (clients) to shut down before the master by setting different `TIMEOUT`, `BATTERYLEVEL`, or `MINUTES` parameters in the config file.

Also, on a slave machine, you do not want to use the modified halt script since it will recall apcupsd, which will detect that it is a slave (i.e. no connection to the UPS) and will complain that it cannot do the killpower. This situation is not harmful just annoying and possibly confusing.

One possible problem during shutdown can be caused by remnants of old versions. Please be sure to delete or rename all prior versions (/usr/local/sbin/apcupsd or /sbin/powersc).

Startup

Normally, apcupsd is automatically started when your system is rebooted. This normally occurs because the startup script apcupsd is linked into the appropriate places in /etc/rc.d. On most Linux systems, there is a program called chkconfig(8) that will automatically link the startup script. This program is invoked by the `make install` scripts, or it is explicitly done for those systems that do not have chkconfig(8). If this is not the case, you can either link it in appropriately yourself or explicitly call it from your rc.local file. The appropriate manual way to startup apcupsd is by executing:

```
<path>/apcupsd start
```

where *path* is normally /etc/rc.d or /etc/rc.d/init.d depending on your system. Using this script is important so that any files remaining around after a power failure are removed. Likewise, shutting down apcupsd should be done with the same script:

```
<path>/apcupsd stop
```

Windows Considerations

Please see the Killpower under Windows chapter of this manual for considerations pertaining to shutdown and killpower on Windows.

APC smart protocol

The APC UPS protocol was originally analyzed by Pavel Korensky with additions from Andre H. Hendrick beginning in 1995, and we want to give credit for good, hard work, where credit is due. After having said that, you will see that Steven Freed built much of the original apcupsd information file.

The start of this chapter of the apcupsd manual in HTML format was pulled from the Network UPS Tools (NUT) site (http://www.networkupstools.org/ups-protocols/apcsmart.html). It has been an invaluable tool in improving apcupsd, and I consider it the Bible of APC UPS programming. In the course of using it, I have added information gleaned from apcupsd and information graciously supplied by APC.

Description

Here's the information on the elusive APC smart signaling protocol used by their higher end units (Back-UPS Pro, Smart-UPS, Matrix-UPS, etc). What you see here has been collected from a variety of sources. Some people analyzed the chatter between PowerChute and their hardware. Others sent various characters to the UPS and figured out what the results meant.

RS-232 differences

Normal 9 pin serial connections have TxD on 3 and RxD on 2. APC's smart serial ports put TxD on pin 1 and RxD on pin 2. This means you go nowhere if you use a normal straight through serial cable. In fact, you might even power down the load if you plug one of those cables in. This is due to the odd routing of pins - DTR and RTS from the PC usually wind up driving the on/off line. So, when you open the port, they go high and *poof* your computer dies.

The Smart Protocol

Despite the lack of official information from APC, this table has been constructed. It's standard RS-232 serial communications at 2400 bps/8N1. Don't rush the UPS while transmitting or it may stop talking to you. This isn't a problem with the normal single character queries, but it really does matter for multi-char things like "@000". Sprinkle a few calls to usleep() in your code and everything will work a lot better.

The following table describes the single character "Code" or command that you can send to the UPS, its meaning, and what sort of response the UPS will provide. Typically, the response shown below is followed by a newline (\n in C) and a carriage return (\r in C). If you send the UPS a command that it does not recognize or that is not available on your UPS, it will normally respond with "NA" for "not available", otherwise the response is given in the "Typical results" column.

Character	Meaning	Typical results	Other info
^A	Model string	SMART-UPS 700	Spotty support for this query on older models
^N	Turn on UPS	n/a	Send twice, with 1.5s delay between chars. Only on 3rd gen SmartUPS and Black Back-UPS Pros
^Z	Permitted EEPROM Values	*long string*	Gives the EEPROM permitted values for your model. See EEPROM Values for details.
A	Front panel test	Light show + "OK"	Also sounds the beeper for 2 seconds
B	Battery voltage	27.87	Varies based on current level of charge. See also Nominal Battery Voltage.

C	Internal Temperature	036.0	Units are degrees C
D	Runtime calibration	!, then $	Runs until battery is below 25% (35% for Matrix) Updates the 'j' values. Only works at 100% battery charge. Can be aborted with a second "D"
E	Automatic self test interval	336	Writable variable. Possible values: • "336" (14 days) • "168" (7 days) • "ON " (at power on) note extra space • "OFF" (never)
F	Line frequency	60.00	Units are Hz. Value varies based on locality, usually 50/60.
G	Cause of last transfer to battery	O	Possible values: • R (unacceptable utility voltage rate of change) • H (high utility voltage) • L (low utility voltage) • T (line voltage notch or spike) • O (no transfers since turnon) • S (transfer due to U command or activation of UPS test from front panel) • NA (transfer reason still not available; read again)
I	Measure-UPS Alarm enable	FF	*not decoded yet*
J	Measure-UPS Alarm status	0F,00	*not decoded yet*
K	Shutdown with grace period (no return)	OK or *	Send twice with > 1.5s delay between chars. Older units send "*" instead of "OK". Length of grace period is set with Grace Period command. UPS will remain off and NOT power on if utility power is restored.
L	Input line voltage	118.3	Value varies based on locality. Does not always read 000.0 on line failure.
M	Maximum line voltage	118.9	This is the max voltage since the last time this query was run.
N	Minimum line voltage	118.1	This is the min voltage since the last time this query was run.
O	Output voltage	118.3	Also see on battery output voltage.
P	Power load %	023.5	Relative to capacity of the UPS.
Q	Status flags	08	Bitmapped, see status bits below

R	Turn dumb	BYE	Only on 3rd gen SmartUPS, SmartUPS v/s, BackUPS Pro. Must send enter smart mode command to resume comms.
S	Soft shutdown	OK	Command executes after grace period. UPS goes online when power returns. Only works when on battery.
U	Simulate power failure	!, then $	See Alert messages section for info on ! and $.
V	Old firmware revision	"GWD" or "IWI"	See Interpretation of the Old Firmware Revision
W	Self test	OK	Tests battery, like pushing button on the front panel. Results stored in "X"
X	Self test results	OK	Possible values: • OK = good battery • BT = failed due to insufficient capacity • NG = failed due to overload • NO = no results available (no test performed in last 5 minutes)
Y	Enter smart mode	SM	This must be sent before any other commands will work. See also turn dumb command to exit smart mode.
Z	Shutdown immediately	n/a	Send twice with > 1.5s delay between chars. UPS switches load off immediately (no grace period)
a	Protocol info	*long string*	Returns three main sections delimited by periods: • Protocol version • Alert messages (aka async notifiers) • Valid commands
b	Firmware revision	50.9.D	See Interpretation of the New Firmware Revision. Decoding the example: • 50 = SKU (variable length) • 9 = firmware revision • D = country code (D=USA, I=International, A=Asia, J=Japan, M=Canada)
c	UPS local id	UPS_IDEN	Writable variable. Up to 8 letter identifier for keeping track of your hardware.
e	Return threshold	00	Writable variable. Minimum battery charge % before UPS will return online after a soft shutdown. Possible values: • 00 = 00% (UPS turns on immediately) • 01 = 15% • 02 = 25% • 03 = 90%

f	Battery level %	099.0	Percentage of battery charge remaining
g	Nominal battery voltage	024	The battery voltage that's expected to be present in the UPS normally. This is a constant based on the type, number, and wiring of batteries in the UPS. Typically "012", "024" or "048".
h	Measure-UPS ambient humidity (%)	042.4	Percentage. Only works on models with Measure-UPS SmartSlot card.
i	Measure-UPS dry contacts	00	Bitmapped hex variable. Mapping: • 10 = contact 1 • 20 = contact 2 • 40 = contact 3 • 80 = contact 4
j	Estimated runtime	0327:	Value is in minutes. Terminated with a colon.
k	Alarm delay	0	Writable variable. Controls behavior of UPS beeper. Possible values: • 0 = 5 second delay after power fail • T = 30 second delay • L = alarm at low battery only • N = no alarm
l	Low transfer voltage	103	Writable variable. UPS goes on battery when voltage drops below this point.
m	Manufacture date	11/29/96	Format may vary by country (MM/DD/YY vs DD/MM/YY). Unique within groups of UPSes (production runs)
n	Serial number	WS9643050926	Unique for each UPS
o	Nominal Output Voltage	115	Expected output voltage when running on batteries. May be a writable variable on 220/230/240 VAC units.
p	Shutdown grace delay	020	Seconds. Writable variable. Sets the delay before soft shutdown completes. (020/180/300/600)
q	Low battery warning	02	Minutes. Writable variable. The UPS will report a low battery condition this many minutes before it runs out of power
r	Wakeup delay	000	Seconds. Writable variable. The UPS will wait this many seconds after reaching the minimum charge before returning online. (000/060/180/300)
s	Sensitivity	H	Writable variable. Possible values: • H = highest • M = medium • L = lowest • A = autoadjust (Matrix only)

t	Measure-UPS ambient temperature	80.5	Degrees C. Only works on models with the Measure-UPS SmartSlot card.
u	Upper transfer voltage	132	Writable variable. UPS goes on battery when voltage rises above this point.
v	Measure-UPS firmware	4Kx	Firmware information for Measure-UPS board
x	Last battery change date	11/29/96	Writable variable. Holds whatever the user set in it. Eight characters.
y	Copyright notice	(C) APCC	Only works if firmware letter is later than O
z	Reset to factory settings	CLEAR	Resets most variables to initial factory values except identity or battery change date. Not available on SmartUPS v/s or BackUPS Pro.
+	Capability cycle (forward)	*various*	Cycle forward through possible capability values. UPS sends afterward to confirm change to EEPROM.
-	Capability cycle (backward)	*various*	Cycle backward through possible capability values. UPS sends afterward to confirm change to EEPROM.
@nnn	Shutdown and return	OK or *	UPS shuts down after grace period with delayed wakeup after nnn tenths of an hour plus any wakeup delay time. Older models send "*" instead of "OK".
0x7f	Abort shutdown	OK	Use to abort @, S, K
~	Register #1	*see below*	See Register 1 table
'	Register #2	*see below*	See Register 2 table
0	Battery constant		See Resetting the UPS Battery Constant
4	*???*		Prints 35 on SmartUPS 1000
5	*???*		Prints EF on SmartUPS 1000
6	*???*		Prints F9 on SmartUPS 1000
7	DIP switch positions		See Dip switch info
8	Register #3	*see below*	See Register 3 table
9	Line quality	FF	Possible values: • 00 = unacceptable • FF = acceptable
>	Number of external battery packs		SmartCell models return number of connected packs. Other models return value set by the user (use +/-).

[	Measure-UPS Upper temp limit	NO,NO	Degrees C. Writable Variable. Possible values: 55, 50, 45, ..., 05. Use +/- to change values.
]	Measure-UPS lower temp limit	NO,NO	Degrees C. Writable Variable. Possible values: 55, 50, 45, ..., 05. Use +/- to change values.
{	Measure-UPS Upper humidity limit	NO,NO	Percentage. Writable Variable. Possible values: 90, 80, 70, ..., 10. Use +/- to change values.
}	Measure-UPS lower humidity limit	NO,NO	Percentage. Writable Variable. Possible values: 90, 80, 70, ..., 10. Use +/- to change values.
Matrix-UPS and Symmetra Commands			
^	Run in bypass mode	BYP, INV, ERR	If online, "BYP" response is received as bypass mode starts. If already in bypass, "INV" is received and UPS goes online. If UPS can't transfer, "ERR" received
<	Number of bad battery packs	000	Count of bad packs connected to the UPS
/	Load current	*nn.nn*	True RMS load current drawn by UPS
\	Apparent load power	*nnn.nn*	Output load as percentage of full rated load in VA.
^V	Output voltage selection		Writable variable. Possible values: • A = automatic (based on input tap) • M = 208 VAC • I = 240 VAC
^L	Front panel language		Writable variable. Possible values: • E = English • F = French • G = German • S = Spanish • 1 = *unknown* • 2 = *unknown* • 3 = *unknown* • 4 = *unknown*
w	Run time conservation		Writable variable. Minutes of runtime to leave in battery (UPS shuts down "early"). Possible values: • NO = disabled • 02 = leave 2 minutes of runtime • 05 = leave 5 minutes • 08 = leave 8 minutes

Dip switch info

Bit	Switch	Option when bit=1
0	4	Low battery alarm changed from 2 to 5 mins. Autostartup disabled on SU370ci and 400
1	3	Audible alarm delayed 30 seconds
2	2	Output transfer set to 115 VAC (from 120 VAC) or to 240 VAC (from 230 VAC)
3	1	UPS desensitized - input voltage range expanded
4-7		Unused at this time

Status bits

This is probably the most important register of the UPS, which indicates the overall UPS status. Some common things you'll see:

- 08 = On line, battery OK
- 10 = On battery, battery OK
- 50 = On battery, battery low
- SM = Status bit is still not available (retry reading)

Bit	Meaning when bit=1
0	Runtime calibration occurring (Not reported by Smart UPS v/s and BackUPS Pro)
1	SmartTrim (Not reported by 1st and 2nd generation SmartUPS models)
2	SmartBoost
3	On line (this is the normal condition)
4	On battery
5	Overloaded output
6	Battery low
7	Replace battery

Alert messages

These single character messages are sent by the UPS any time there is an Alert condition. All other responses indicated above are sent by the UPS only in response to a query or action command.

Character	Meaning	Description
!	Line Fail	Sent when the UPS goes on-battery, repeated every 30 seconds until low battery condition reached. Sometimes occurs more than once in the first 30 seconds.
$	Return from line fail	UPS back on line power. Only sent if a ! has been sent previously.
%	Low battery	Sent to indicate low battery. Not implemented on SmartUPS v/s or BackUPS Pro models
+	Return from low batt	Sent when the battery has been recharged to some level Only sent if a % has been sent previously.
?	Abnormal condition	Sent for conditions such as "shutdown due to overload" or "shutdown due to low battery capacity". Also occurs within 10 minutes of turnon.

=	Return from abnormal condition	Sent when the UPS returns from an abnormal condition where ? was sent, but not a turn-on. Not implemented on SmartUPS v/s or BackUPS Pro models.
*	About to turn off	Sent when the UPS is about to switch off the load. No commands are processed after this character is sent. Not implemented on SmartUPS v/s, BackUPS Pro, or 3rd generation SmartUPS models.
#	Replace battery	Sent when the UPS detects that the battery needs to be replaced. Sent every 5 hours until a new battery test is run or the UPS is shut off. Not implemented on SmartUPS v/s or BackUPS Pro models.
&	Check alarm register for fault (Measure-UPS)	Sent to signal that temp or humidity out of set limits. Also sent when one of the contact closures changes state. Sent every 2 minutes until the alarm conditions are reset. Only sent for alarms enabled with I. Cause of alarm may be determined with J. Not implemented on SmartUPS v/s or BackUPS Pro.
|	Variable change in EEPROM	Sent whenever any EEPROM variable is changed. Only supported on Matrix UPS and 3rd generation SmartUPS models.

Register 1

All bits are valid on the Matrix UPS. SmartUPS models only support bits 6 and 7. Other models do not respond.

Bit	Meaning when bit=1
0	In wakeup mode (typically lasts < 2s)
1	In bypass mode due to internal fault (see Register 2 or Register 3)
2	Going to bypass mode due to command
3	In bypass mode due to command
4	Returning from bypass mode
5	In bypass mode due to manual bypass control
6	Ready to power load on user command
7	Ready to power load on user command or return of line power

Register 2

Matrix UPS models report bits 0-5. SmartUPS models only support bits 4-6. SmartUPS v/s and BackUPS Pro report bits 4, 6, 7. Unused bits are set to 0. Other models do not respond.

Bit	Meaning when bit=1
0	Fan failure in electronics, UPS in bypass
1	Fan failure in isolation unit
2	Bypass supply failure
3	Output voltage select failure, UPS in bypass
4	DC imbalance, UPS in bypass
5	Battery is disconnected
6	Relay fault in SmartTrim or SmartBoost
7	Bad output voltage

Register 3

All bits are valid on the Matrix UPS and 3rd generation SmartUPS models. SmartUPS v/s and BackUPS Pro models report bits 0-5. All others report 0-4. State change of bits 1,2,5,6,7 are reported asynchronously with ? and = messages.

Bit	Meaning when bit=1
0	Output unpowered due to shutdown by low battery
1	Unable to transfer to battery due to overload
2	Main relay malfunction - UPS turned off
3	In sleep mode from @ command (maybe others)
4	In shutdown mode from S command
5	Battery charger failure
6	Bypass relay malfunction
7	Normal operating temperature exceeded

Interpretation of the Old Firmware Revision

The Old Firmware Revision is obtained with the "V" command, which gives a typical response such as "GWD" or "IWI", and can be interpreted as follows:

```
Old Firmware revision and model ID String for SmartUPS & MatrixUPS

This is a three character string XYZ

   where X == Smart-UPS or Matrix-UPS ID Code.
     range 0-9 and A-P
       1 == unknown
       0 == Matrix 3000
       5 == Matrix 5000
     the rest are Smart-UPS and Smart-UPS-XL
       2 == 250       3 == 400       4 == 400
       6 == 600       7 == 900       8 == 1250
       9 == 2000      A == 1400      B == 1000
       C == 650       D == 420       E == 280
       F == 450       G == 700       H == 700XL
       I == 1000      J == 1000XL    K == 1400
       L == 1400XL    M == 2200      N == 2200XL
       O == 3000      P == 5000

   where Y == Possible Level of Smart Features, unknown???
       G == Stand Alone
       T == Stand Alone
              V == ???
       W == Rack Mount

   where Z == National Model Use Only Codes
       D == Domestic        115 Volts
       I == International   230 Volts
       A == Asia ??         100 Volts
       J == Japan ??        100 Volts
```

Interpretation of the New Firmware Revision

```
New Firmware revision and model ID String in NN.M.L is the format

    where NN == UPS ID Code.
        12 == Back-UPS Pro 650
        13 == Back-UPS Pro 1000
        52 == Smart-UPS 700
        60 == SmartUPS 1000
        72 == Smart-UPS 1400

        where NN now Nn has possible meanings.
            N  == Class of UPS
            1n == Back-UPS Pro
            5n == Smart-UPS
            7n == Smart-UPS NET

             n == Level of intelligence
            N1 == Simple Signal, if detectable WAG(*)
            N2 == Full Set of Smart Signals
            N3 == Micro Subset of Smart Signals

    where M == Possible Level of Smart Features, unknown???
        1 == Stand Alone
        8 == Rack Mount
        9 == Rack Mount

    where L == National Model Use Only Codes
        D == Domestic        115 Volts
        I == International   230 Volts
        A == Asia ??         100 Volts
        J == Japan ??        100 Volts
        M == North America   208 Volts (Servers)
```

EEPROM Values

Upon sending a ^Z, your UPS will probably spit back approximately 254 characters something like the following (truncated here for the example):

```
#uD43132135138129uM43229234239224uA43110112114108 ....
```

It looks bizarre and ugly, but is easily parsed. The # is some kind of marker/ident character. Skip it. The rest fits this form:

- Command character - use this to select the value
- Locale - use 'b' to find out what yours is (the last character), '4' applies to all
- Number of choices - '4' means there are 4 possibilities coming up
- Choice length - '3' means they are all 3 chars long

Then it's followed by the choices, and it starts over.

Matrix-UPS models have ## between each grouping for some reason.

Here is an example broken out to be more readable:

```
CMD DFO RSP FSZ FVL
u   D   4   3   127 130 133 136
u   M   4   3   229 234 239 224
u   A   4   3   108 110 112 114
u   I   4   3   253 257 261 265
l   D   4   3   106 103 100 097
l   M   4   3   177 172 168 182
l   A   4   3   092 090 088 086
l   I   4   3   208 204 200 196
e   4   4   2   00   15  50  90
o   D   1   3   115
o   J   1   3   100
o   I   1   3   230 240 220 225
o   M   1   3   208
s   4   4   1     H   M   L   L
q   4   4   2    02  05  07  10
p   4   4   3   020 180 300 600
k   4   4   1     0   T   L   N
r   4   4   3   000 060 180 300
E   4   4   3   336 168  ON OFF

CMD == UPSlink Command.
    u = upper transfer voltage
    l = lower transfer voltage
    e = return threshold
    o = output voltage
    s = sensitivity
    p = shutdown grace delay
    q = low battery warning
    k = alarm delay
    r = wakeup delay
    E = self test interval

DFO == (4)-all-countries (D)omestic (I)nternational (A)sia (J)apan
     (M) North America - servers.
RSP == Total number possible answers returned by a given CMD.
FSZ == Max. number of field positions to be filled.
FVL == Values that are returned and legal.
```

Programming the UPS EEPROM

There are at this time a maximum of 12 different values that can be programmed into the UPS EEPROM. They are:

Command	Meaning
c	The UPS Id or name
x	The last date the batteries were replaced
u	The Upper Transfer Voltage
l	The Lower Transfer Voltage
e	The Return Battery Charge Percentage
o	The Output Voltage when on Batteries
s	The Sensitivity to Line Quality

p	The Shutdown Grace Delay
q	The Low Battery Warning Delay
k	The Alarm Delay
r	The Wakeup Delay
E	The Automatic Self Test Interval

The first two cases (Ident and Batt date) are somewhat special in that you tell the UPS you want to change the value, then you supply 8 characters that are saved in the EEPROM. The last ten item are programmed by telling the UPS that you want it to cycle to the next permitted value.

In each case, you indicate to the UPS that you want to change the EEPROM by first sending the appropriate query command (e.g. "c" for the UPS ID or "u" for the Upper Transfer voltage. This command is then immediately followed by the cycle EEPROM command or "-". In the case of the UPS Id or the battery date, you follow the cycle command by the eight characters that you want to put in the EEPROM. In the case of the other ten items, there is nothing more to enter.

The UPS will respond by "OK" and approximately 5 seconds later by a vertical bar (|) to indicate that the EEPROM was changed.

NIS Network Server Protocol

The NIS network server in apcupsd is capable of sending status and events data to clients that request it. The communication between the client and the server is performed over a TCP connection to the NISPORT (normally port 3551). The client opens a connection to the server and sends a message, to which the server will reply with one or more messages. Each message consists of a 2-byte length (in network byte order) followed by that many bytes of data. Both the client->server and server->client messages follow this format.

apcupsd supports two commands, sent as the body of a message:

1. "status" - The status command requests that the server send a copy of all status values, in the form displayed by apcaccess. After the client sends the "status" command, the server will reply with a series of messges, each one containing one line of apcaccess status data. The end of the command series is indicated by an empty message (length of 0).
2. "events" - The events command operates the same as "status" except the server replies with lines from the log of recent events.

As an example, the following bytes would be sent by a client to solicit the status:

```
0x00 0x06 0x73 0x74 0x61 0x74 0x75 0x73
```

The first two bytes are the data length (6) in network byte order. The 6 bytes of data that follow are the ASCII characters for "status". The server will respond to this command with a series of its own messages containing the status data.

Apcupsd RPM Packaging FAQ

How do I build Apcupsd for platform xxx?

The apcupsd spec file contains defines to build for several platforms: RedHat 7.x (rh7), RedHat 8.0 (rh8), RedHat 9 (rh9), Fedora Core (fedora_core), RedHat Enterprise Linux and clones (rhel3 and rhel4), SuSE 9 & 10 (suse), and Mandrake (mdk). The package build is controlled by a define set at the beginning of the file. These defines basically just control the dependency information that gets coded into the finished rpm package. So while you could technically build a package without defining a platform, or with an incorrect platform, and have it install and run it would not contain correct dependency information for the rpm database. The platform define may be edited in the spec file directly (by default all defines are set to 0 or "not set"). For example, to build the RedHat 7.x

package find the line in the spec file which reads

```
%define rh7 0
```

and edit it to read

```
%define rh7 1
```

Alternately you may pass the define on the command line when calling rpmbuild:

```
rpmbuild -ba --define "build_rh7 1" apcupsd.spec
rpmbuild --rebuild --define build_rh7 1" apcupsd-x.x.x-x.src.rpm
```

How do I control whether usb support gets built?

Up through version 3.12, by default standard serial port support was built and the apcupsd-std package was produced. The usb package pre-configured the configuration files for usb devices and installed a couple additional tools in /etc/apcupsd but the usb driver was built regardless. To get the usb package and support in those versions either set the

```
%define usb 0
```

to

```
%define usb 1
```

in the spec file directly or pass it to rpmbuild on the command line:

```
rpmbuild -ba --define "build_rh7 1" --define "build_usb 1" apcupsd.spec
```

With the release of 3.14 USB support is now considered standard and the apcupsd-std and apcupsd-usb packages are obsoleted in favor of a single apcupsd package configured for usb connected UPS's. The serial port driver is still built and can be configured accordingly after installation. If you are performing an upgrade it will of course not replace your current config file.
The build directive:

```
--define "build_usb 1"
```

is no longer recognized.

What other defines are used?

There is a define for the initdir for the daemon control script. On RedHat or Mandrake systems this is set to /etc/rc.d/init.d/. On SuSE systems this is set to /etc/rc.d. You would only need to edit this if packaging for a platform that uses a different directory.
A second define controls whether the Gnome monitoring application, new in the 3.14 release, is built. This application requires the Gtk2 version to be >= 2.4. If you want to build the apcupsd-gapcmon package add:

```
--define "build_gapcmon 1"
```

A third define controls whether the SNMP driver is built. If you want to build the net-snmp driver add:

```
--define "build_snmp 1"
```

Can I supply packages for other platforms you do not publish?

Yes, there are tools provided for contributors to supply rpm packages for platforms for which support is provided in the spec file but for which the development team chooses not to release binary packages, usually due to lack of interest or lack of an available platform. Please see platforms/contrib/README in the source package.

I'm getting errors about not having permission when I try to build the packages. Do I need to be root?

No, you do not need to be root and, in fact, it is better practice to build rpm packages as a non-root user. Apcupsd's packages are designed to be built by a regular user but you must make a few changes on your system to do this. If you are building on your own system then the simplest method is to add write permissions for all to the build directory (/usr/src/redhat/). To accomplish this execute one of the following commands as root depending on your distribution, RedHat, SuSE or Mandriva, respectively:

```
chmod -R 777 /usr/src/redhat
chmod -R 777 /usr/src/packages
chmod -R 777 /usr/src/RPM
```

If you are working on a shared system where you can not use the method above then you need to recreate the /usr/src/redhat (or other) directory tree with all of it's subdirectories inside your home directory. Then create a file named

```
.rpmmacros
```

in your home directory (or edit the file if it already exists) and add the following line:

```
%_topdir /home/myuser/redhat
```

Credits

The success of apcupsd is due to the many people that helped in development, testing and in many other ways.

Thank all the developers that worked hard to make APCUPSD one of the best piece of software for UPS management.

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